THE SURVEYOR, ENGINEER, AND ARCHITECT;

OR,

LONDON MONTHLY JOURNAL OF THE PHYSICAL AND PRACTICAL SCIENCES

IN ALL THEIR DEPARTMENTS.

ADDRESS TO OUR READERS.

The painful duty devolves upon us of announcing to the readers of this Journal the decease of Mr. Mudie, the original projector of the work, and its literary conductor from the commencement. The memory of this distinguished man deserves a longer notice than our pages will admit of. Yet, however inadequate may be the space at our command for doing justice to the splendid talents and the varied and profound acquirements which his powerful mind has exercised for the advancement of physical science, and of the engineering arts in particular, we cannot suffer that this, the first number of his own cherished creation which appears without his well-known name upon its cover, should be wanting in such a tribute of respect and admiration for his memory as we are able to furnish. In another part of the Journal, therefore, will be found a brief biographical sketch of Mr. Mudie; and in the mean time it will be necessary to say a few words to our readers and correspondents, relative to the future conduct of the Journal, and to the change of management consequent upon the melancholy event we have alluded to.

The grand object sought to be carried out in the "Surveyor," has hitherto been that of applying the physical sciences to the practice of those three important professions which afford the title of the work. This was the great object which Mr. Mudie had originally in view, and which he has endeavoured to carry out as successfully as possible. At the same time that it was intended thus to constitute the Journal a work of permanent reference, it was considered necessary to invest it with so much of the magazine character, as to make it the vehicle of new and interesting information on all subjects connected with the professions, although these subjects might not be of a directly scientific nature. It will be admitted that this latter intention was scarcely of less consequence than the former, when we consider the deficiency of information on professional subjects in any thing like a connected form. It is true that a great mass of scraps connected with the progress of architecture and engineering in all parts of the country, is distributed through the local newspapers; but the information of these, on account of the scattered, irregular, and insufficient form in which it appears, furnishes no general view of the progress and condition of architectural and engineering works. That such a general view may be acquired, the labour of compilation at least is necessary, and that information so scattered and diffused may be combined, it is required to have access to a greater host of newspapers and other prints than professional men can usually afford the time to consult.

It was intended, then, that this Journal should present, together with its standard scientific object, a current history of the professional works of which this country has ever been, and will long continue to be, the theatre. How far the double intention here expressed has hitherto been carried out, the public and the readers of the Journal will be able to judge for themselves; but it will be expected that some announcement should be made for the future.

In the first place, then, we are actuated by an earnest desire to infuse new life and vigour into all departments of the work; and secondly, we have made arrangements for varying and breaking the monctony which some have complained of in its pages, by the introduction to a greater extent of those brief and stirring topics of the day, which are connected with science and the arts. It depends in a great measure upon the professions for whose use this Journal is intended, whether or not we shall be able successfully to carry these designs into effect.

It will be known to many of our readers, that the ordinary amount of sale which would amply remunerate the author of a book on almost any subject, whether literary or scientific, would be far from sufficient to pay the absolutely necessary expenses connected with a periodical. A larger circle of readers and purchasers must therefore be reckoned upon in the latter case; and it follows, that the same topics which would simply or barely command a sale when they composed a book, would utterly fail to realise that extensive sale which is necessary in the case of a magazine.

Hence it appears, even without the aid of that most rare touchstone—actual experience—that, however valuable may be the contents of a magazine, considered merely as treatises or essays upon the variety of subjects introduced into its pages, these cannot be expected to excite and to keep up that general interest which alone can cause the work to succeed. Such essays and treatises are to be found in all scientific books, and we need not say to authors and publishers how rare are the instances where such books produce a remunerative return. How, then, is the magazine to be distinguished from mere books, for which a limited sale only is expected, and to which even that limited sale is often denied? Simply by the novelty of its contents; by the modern date of its information; by the opportunities it enjoys of seizing upon every passing event connected with its professed objects, and bringing out before its readers the latest particulars of all such events.

At the same time, original articles of merit upon science and the arts are by no means to be neglected, because we are unwilling that the work should degenerate into a news sheet, or into a mere depôt for unconnected scraps.

No undue preference is to be exercised in the editorial department for any one or two of the professions from which our readers are derived: the only test of fitness which will be applied to any article submitted for insertion, will be that of its general value or utility. We contend, that there is great injustice in the complaints of either engineers or architects (and we have heard complaints from both), that their individual professions are not sufficiently represented in this Journal. To those who complain in this manner we would say, Let us have your support by means of information connected with your own profession; and, whilst we for our part shall be most happy to make use of it in the pages of the Journal, our mutual interests will be served, and one step at least will be

made to remove your own cause of complaint. If any one, therefore, should feel disposed to quarrel with us for neglect of the particular profession to which he is attached, let him reflect, that the fault of which he complains is not wholly ours; but, on the contrary, that the blame rests in some degree upon that very neglected profession itself, and upon himself individually as one of its members. It is time to complain of deficiency, when articles of merit, which would have supplied that deficiency, have been refused or neglected. Such being the case with respect to the due representation of the three professions, we do most sincerely and unaffectedly invite the co-operation of all the classes composing them.

It is almost impossible to appreciate the value of that aggregate mass of useful knowledge with which every day's experience enriches the actually practical members of each; we mean those who, either as builders, contractors, architects, clerks of works, or resident engineers, are charged with the actual execution and the immediate superintendence of large public works. We can admire the genius of the great projector,—the fertility of his invention and the boundless resources of his intellect. We would abate not one leaf from the ideal laurel with which posterity will encircle his brow; but when all the homage of the most revering admiration has been extended to the inventor, the designer, or the originator of any work where nature is to be extensively dealt with, we would still claim for the humbler instrument who watches its progress day by day, a consideration for the experience thereby derived, which should induce him to neglect no opportunity of gaining that experience, and of improving it to the best advantage. The experience of the resident engineer, or, we might say, of practical men generally, no matter to what class they belong, furnishes in fact the principal ground-work for the operations of the highest class, or it is the foundation on which designs for future works are conceived and matured. Need we, therefore, to urge the importance of giving every publicity to the daily experience of the practical man? Need we travel through the minute details of his practice to show, that not a single day, if energetically employed, can pass away without adding to his knowledge of physical combinations, and of the relations of time, capital, and labour to effect these combinations. All this minuteness of explanation can scarcely be necessary in addressing a body so intelligent as the executive part of the constructive professions. But we cannot insist too strongly upon the necessity of direct communication between this executive body and the conductor of any journal which is to be of real, substantial utility to the world, and to the professions in particular. The works and the proceedings of great architects and great engineers are of necessity more public than the quiet and steady labours of the practical man. A knowledge of them is therefore more easily procurable, and we shall not fail to avail ourselves of all those reports and other documents proceeding from the heads of the professions, which contribute to throw light on the progressive spirit of public enterprise, and to diffuse a stimulus to exertion throughout every district capable of improvement. But, as we have already said, we *must* have direct communication from the works themselves, that is, from those who carry them on; it is only thus that we can hope to confer lasting benefit on the professions, and that each individual member can confer and receive mutual benefit through the medium of this Journal. It will surely not be urged at this day, that men engaged in the various applications of practical science are interested in keeping up a wall of secrecy around their proceedings, and that the publication of practical facts is injurious to the constructive professions as a body, although it may often produce individual gain. Let us examine this assertion; or rather, let us oppose to it another, of which, in candour, every one must admit the truth, and the former becomes at once extinguished. All the secrets of the professions, then, *are* published,—witness the Transactions of the Institution of Engineers and the Institute of Architects,—witness the papers of the Royal Engineers, to say nothing of the annual volumes of several learned societies, which contain by no means a small proportion of professional matter,—witness, again, the host of elaborate and expensive works, with plates often executed in the highest style of art, which a few spirited publishers in this country have given to the world; and who can deny that an immense mass of professional knowledge is constantly becoming public? Now, admitting that this knowledge is to become public at last, and admitting, again, what is equally true, that if it fail to become so through one particular channel, it will by some other; and what can then be left to decide on, except the comparative advantage of one medium over another? Here, then, the question simply is, Whether it be expedient that professional information should be published at short periodical intervals, or whether it should be stored up for one or more years, to grace the pages of a learned volume of Transactions? It is, Whether the results of practical experience, and the fruits of patient and diligent research, should be given to the world at once, and in time to be of service, and in time to supersede others, who may be all the while labouring at similar objects; or whether it shall be destined to swell the archives of some society, with the remote chance of publication at a time indefinitely distant, and with the certain chance of its value being greatly impaired in the eyes of every one, on account of the antique date of its production.

We cannot pretend to bring in array all the reasons which should induce professional men to avail themselves of the mutual advantage afforded by a journal thus candidly volunteering in their service; but it is certain, that the more the subject is considered, the more will the intelligent and inquiring of all the professions be convinced of the active and eminent services which they have it thus in their power to call forth.

At the same time that we are led to anticipate a new impulse in favour of the work to be received through the communications of the professions themselves, we have no intention of abating our individual exertions. We shall confidently appeal to the present and the next succeeding number, to show an improvement in the work, professionally considered. It is true, the Journal has lost for ever the assistance of Mr. Mudie's valuable papers on physical science, which eminently served to keep up the standard spirit of the work, and which were generally admired by all classes of readers. It is the intention of the proprietors to supply the loss of these papers by a certain portion of matter relating to mechanical engineering, and by an increased range of architectural subjects.

It is also one main feature of the new arrangement, to devote more space to reviews than that which has hitherto been allotted to them. The want of a good review for scientific works has been generally complained of, and the complaint applies much more strongly to scientific books which are purely professional. The present number exhibits a deficiency of review, and in other respects it fails to realize the designs of those to whom its management is entrusted; but this must be attributed to the briefness of the time in which the arrangements had to be made, between the interval of Mr. Mudie's lamented death, and the necessary time of preparation for the present number.

NAVAL ARCHITECTURE.

SPECIFICATION OF A STEAM VESSEL OF 775½ TONS AND 300 HORSES POWER, BUILT IN THE THAMES; AND FORM OF AGREEMENT BETWEEN THE CONTRACTING PARTIES.

ARTICLES OF AGREEMENT

CONCLUDED and agreed upon the ——— day of ——— in the year of our Lord one thousand eight hundred and thirty-five. Between ———. WHEREAS the said ——— have agreed to build for the said ———, the hull or body of a ship or vessel to be propelled by steam, of the dimensions hereinafter written, and to launch the same at the time, and for the price or sum hereinafter expressed. NOW THEREFORE these presents witness that, in pursuance of the said agreement, and in consideration of the covenants hereinafter contained by and on the part of the said ———, they the said ——— do hereby, for themselves jointly and severally, and for their and each of their heirs, executors, and administrators, covenant, promise, and agree to and with the said———, their executors, administrators, and assigns, That they the said ——— shall and will, at their own proper costs and charges, in a good, strong, substantial, and workmanlike manner, construct and build for the said ———, the hull or body of a ship or vessel to be propelled by steam, of good, sound and well-seasoned timber and plank, and proper materials of every kind, conformably to and of the description and dimensions, and in the manner particularly mentioned and set forth in the specification hereinafter written, or hereunto annexed, and shall and will complete the said vessel in every respect fit to receive the engines, and launch and deliver her safe afloat into the charge of some person or persons appointed to receive her, as is customary in the river Thames, by the said——— on or before the ——— day of ———.

AND these presents further witness, that, in consideration of the covenants and agreements hereinbefore contained by and on the part of the said ———, they the said ——— do hereby for themselves, their heirs, executors, and administrators, covenant, promise, and agree with and to the said ———, their executors and administrators, that they the said ———, their executors and administrators, shall and will truly pay or cause to be paid to the said ———, their executors or administrators, the sum of ——— per ton for as many tons as the said vessel shall measure, according to the measurement of the surveyor of the customs of the port of London, not excluding the length of the engine-room, which payments are to be made at the times and in the manner following, viz:—

	£	s.	d.
1st. On signing the contract . .	2195	0	0
2nd. When the keel is laid, and the stem and stern post up, and the floors prepared .	2195	0	0
3rd. When the frame is complete . .	2195	0	0
4th. When the outside and inside is wrought and diagonal work complete . .	2195	0	0
5th. When the deck is laid . .	2195	0	0
6th. And final payment when the vessel is finished, launched, and, so far as all the works which the said ——— have hereby agreed to do is concerned, complete, the balance .			
£			

Should these payments, when due, not suit the convenience of the said ———, it is hereby further agreed that the credit shall be extended for any time not exceeding two years, at the option of the said ———, who do hereby agree to pay to the said ——— interest from the time such payments shall have become due at the rate of four per cent. per annum, until payment thereof shall be fully made. AND it is hereby further agreed, that the said ——— shall, at their own expense, insure the hull of the said vessel from fire during the time she is building, and until she is launched and delivered into the hands of the persons appointed to receive her, and in case of any damage arising from fire, a reasonable time to be allowed for repairing and making good such damage. PROVIDED ALWAYS, and it is hereby further agreed by and between the said parties hereto, that no addition or alteration or substitution in the works of the said vessel, as set forth in the specification hereunto annexed, or in all or any part or parts thereof, by which any additional expense shall be incurred, shall be made without the license and authority in writing of the said ———, or their surveyor or overseer; and should any such addition, alteration, or substitution in the works of the said vessel, or in all or any part or parts thereof, be made with such license or authority in writing as aforesaid, such addition, alterations, and substitutions shall be carried into execution, and the respective works necessary for that purpose shall be done and completed by the said ——— in the same way and manner, and within the same time, as is and are in these presents covenanted to be done, and the same shall be valued and paid for without vitiating any of the terms of this contract.

AND it is hereby agreed to between the said parties, that, in case of a strike or standing out of the shipwrights or other workmen usually employed in building ships in the river Thames, and refusing to work, so much further time shall be allowed for building and completing the said vessel.

AND the said ———, their executors, administrators, or assigns, shall have the liberty to appoint an overseer to inspect the works of the said vessel, which are to be performed in a workmanlike manner, according to the terms of this contract, and the particulars described in the specification annexed.

SPECIFICATION

Referred to, of a Steam-ship of 775$\frac{6}{94}$th tons, to be propelled by a pair of 150 horses power engines, and to draw 13 feet water.

	Feet.	In.
Length.—From the fore part of the stem to the aft part of the stern post upon deck . . .	180	
Breadth.—Extreme, 30 feet, and moulded .	29	4
Length.—From the fore part of the stem to the aft part of the stern post at the rebate of the keel .	180	
Length of the engine-room . . .		
Depth in hold	20	
Burthen in tons	775$\frac{6}{94}$ths.	

Sheer forward, 2 ft. 6 in.; aft, 1 foot.

Keel.—English Elm. In midships, 13 in. sided, 14 in. deep; at the fore and the after ends, 12 in. sided,; below the rebate, 4 in.; the scarphs, 60 in. long; bolted with six bolts, ¾ in. diameter.

Stem.—English Oak. In one piece at the head, 14 in. sided; at the keel, 12 in. sided; 17 in. moulded.

Stemson.—Oak. 13 in. sided; to mould to suit the drawing; to be bolted through the stem every two feet with bolts, 1 in. diame-

ter, copper. Stem and stern post to be connected to keel with two copper plates or stirrups, bolted through each other and clenched; forms as required.

Apron.—Oak. Sided same as stern, and to run not less than ten feet along the keelson; to be well fitted and bolted with bolts, 1 in. diameter, copper.

Stern Post.—African. At the head, 13 in. square; fore and aft on the keel, 25 in. sq.; abaft the rebate at wing transom, 7 in.; at the keel, 12 in.

Inner Post.—African or Oak. To run up to the under side of the wing transom; fore and aft at the head, 10 in.; at the keel, 14 in. To be bolted at the head with two bolts, through the main post, and clenched, 1 in. diameter, copper.

Wing Transom.—African or Oak. 13 in. sided; in midships, 15 in. moulded. To have two bolts through stern post, 1 in. diameter, copper. To be secured with an iron knee at each end; the fore and aft arm to have four bolts, one in each timber, and three in the thwartships arm through the transom, 1 in. diameter. To have no other transom, but all the timbers to be dowelled at their heads to the under side of the transom, and bolted at their heel with bolts, ⅞ in. diameter.

Deadwood.—Oak and Elm. Sided the same as the keel; may be reduced in the cant body two inches on each side above the stepping line; to be sufficiently high for the security of the keels of the cant timbers; to have a knee of English oak or iron against the stern post; the fore and aft arm, if wood, to be scarphed on the keelson, and sided same as the keelson, to be bolted two feet apart, with bolts 1⅛ in. diameter. The lower piece may be English elm; all above the lower piece to be English oak.

Keelson.—African. In midships, to be sided and moulded same as the keel; to be bolted through every floor and the keel, with bolts, 1⅛ in. diameter; the scarphs, 54 in. long; and six feet clear of the masts and scarphs of the keel.

Fashion Pieces.—To be double; the foremost one to run up three feet above the wing transom, and to be dowelled to its end; the after one to run up to the under side of the wing transom, and be dowelled into it, 9 in. sided.

Knighthead.—Oak. At the head, 13 in. sided; to be coaked to the stem and apron, and bolted athwartships, 1 in. diameter.

Hause Pieces and Chocks.—Oak. Three on each side, 11 in. sided; to run up within one foot of the top of the knighthead; the hause holes to be fitted with cast-iron pipes, 10 in. diameter. Hause chocks, oak, 16 in. moulded, with a view to keep the anchor clear of fore foot when heaving it up.

Room and Space.—For sixty feet on the whole length of engine-room, to be perfectly solid to the turn of the bilge, and caulked; space between paddle beams in wake of shaft, to be perfectly solid to the gunwale, and to be before and abaft the engine-room for 34 feet, 10 in. sided; and the space to be fitted up as high as the turn of the bilge, fore and abaft, with red pine or Memel, so as to make the bottom close, and then paid with pitch within and without.

Cross Pieces or Shut Floors,—in the engine-room, 13 by 12 in. sided; before and abaft ditto to be reduced to 10 in.; at the cutting down, 13 in. moulded; at the heads, 13 in. moulded.

Scarphs.—Not to be less than five feet in the keel, stem, stern posts, keelsons, beams and stringers, each to have felt in the joints, and coaked; those of the keel and stern posts to be bolted with copper inch bolts, and clenched in rings.

Floors.—In the engine-room, 13 by 12 in. sided; before and abaft, reduced to 10 in. sided; at the heads, 12½ in. moulded.

Futtocks.—The second futtocks between the paddle beams, and extending two feet before and two feet abaft them, to be at their heels, 12 in. square; tapering up to the head of the top futtocks, to 8 in. moulded, 12 in. sided. The same as the floors, to be bolted together horizontally every three feet space, so as to form one compact body; the rest of the second futtocks, for the space of sixty feet amidships, to be at their heels 12 in. square; tapering up to the head of the top futtocks to 6 in. moulded; and sided same as the frame, and bolted horizontally as above. The futtocks forward and abaft to reduce in the sidings to 8 in., and in the moulding to 5 in.; to be built in frame, and firmly secured at their heads and heels, side filling from 12 to 15 inches long, filled between the frames. The entire of the futtocks to be square at their heads and heels, and united at their points, 2½ inch African dowels. In the wake of the beams of the main deck, which extend to the sponsons under each beam at the inboard spring of the sponson, a stantion be placed, and bolted to each side, and to the beam. These stantions to be used from after paddle beams to the after bulkhead in boiler-room; the futtocks to be moulded according to a tapering line between the floor head and the top of the side.

Main Wales.—African teak or English oak, 6 in. thick; in four strakes together, 40 in. broad.

Plank of the Bottom.—American elm. Garboard strake in midships, 9 in. thick; tapered forward and abaft to the thickness of the bottom; bolted through each other at about 3 feet apart, with bolts ⅞ in. diameter. Also up and down into the floors, to be planked from the garboard strakes up to the 8 feet mark, with American elm, 4½ in. thick; hence to the under part of the wales, with Dantzic fir, 4 in. thick.

Sheer Strakes.—African. To have two together, 24 in. broad, 4 in. thick.

Top Side.—African or Dantzic. The number of strakes, two together, 22 in. broad, 5 in. thick; the remainder, forward and aft, 3 in. thick.

Plansheer or Gunweal.—African. 4 in. thick.

Stern and Counter.—Oak. 8½ by 6½ inches at the heel, diminishing to 6½ by 5 inches at the head; to have an oak clamp across the counter inside, 6 by 8 inches, to be trenailed to the timbers, and secured to the quarters by 2 iron knees; the counter to be planked with oak, 3 in. thick.

WITHIN BOARD.

Thick Strakes.—Oak plank. Five strakes, 4½ in. thick; amidships, 12 in. broad; three strakes forward and aft, the upper and lower planks to be bolted every four feet between the diagonal straps, with copper bolts, ⅞ in. diameter; and clenched on rings, and the whole to be trenailed.

Shelf Pieces, and all other Stringers, to be African Oak, except Quarter-deck.—For the sixty feet corresponding with the solid floor, the stringer to be oak, 12 in. square; tapering forward and aft that space to 9 in. sided, 12 in. moulded. To be bolted through every timber, and clenched on rings. This stringer to extend six feet abaft the break of the quarter-deck, running aft to the stern, and secured in like manner; a break in the stringer between the paddle beams, so as to allow the paddle beams to rest on the lower part, as in the plan; the overlap of the stringer to be 8 feet, and to be bolted through every timber as above, and through the cor-

responding part of the stringer every foot, and clenched on rings. The stringers to be dowelled to each other between the paddle beams. Two strong iron knees, 6 in. broad, tapered to 1½ in. thick, at the throat 5½ in. thick, at each side, each extending 10 feet along the side of the vessel, and bolted through every second timber, and six feet along the paddle beams, to be clenched on rings, 1¼ in. diameter, iron; stringers under quarter-deck, Dantzic fir, 9 in. sided, 12 in. moulded; bolted and fastened as forward, and secured to beams at break of quarter-deck and stern.

Under Stringer.—A second stringer to extend under the beams of the cabin sole, fore and aft through engine-room, and as far forward as the after bulkhead of the fore cabin; amidships, 10 in. moulded, tapering aft to 7 in.; 8 in. sided; to be bolted through every timber with bolts ¾ in. in diameter, and clinched on rings to be fastened to the transom by iron knees; stringer under the fore cabin sole, oak, 10 in. moulded, 8 in. sided, tapering forward to 8 by 7 inches, to extend from stem as far aft as foremost paddle beam, secured as above. Another stringer for deck, under after cabin sole, same as above.

Paddle Beam.—African Oak. 22 in. moulded; 18 in. sided; scarphs, 8 feet, to be secured by adequate iron knees and stays, and well bolted. Four run pieces, running from ends of paddle beams to vessel's sides, amply secured.

Upper Deck Beams.—Oak. Five between the paddle beams; 11 in. sided, 9 in. moulded; the same timber and scantling before and abaft the fore and main hatchways, on all the decks, and that over the foremost part of the boiler secured by iron knees, the remainder of the beams before the engine room, and abaft the main hatchway, to be 11 in. sided, 9 in. moulded; three feet space, or to accommodate hatches; coaked to the stringer, and secured by light iron knees. The beams over the boilers to be oak, with dog bolts, or light iron knees, all the bolts driven through and clenched on rings. One oak beam across the engine-room, just abaft the cylinders, to be firmly bolted to the second stringer, and secured to the side by two iron lodging diagonal knees at each end, the lodging knees 3 inches, in the throat 4 in. by 2½ in. tapering to 1½ in.; bolts, 1⅛ in. diameter.

Quarter Deck Beams.—Dantzic pine. 10 in. sided, 9 in. moulded; three feet space; that at the break of quarter-deck African oak, 10 in. sided, 12 in. moulded; to be rabitted to receive the ends of the quarter-deck plank, and to project before the bulk head 3 in., and finished with suitable moulding; the oak beam to be secured by iron knees, and the Dantzic beams with light iron knees.

Beams under Cabins.—Oak. Those at hatchways 9 in. sided, 10 in. moulded; the rest, 9 in. sided, 8 in. moulded; coaked to the stringer; all the beams to have light iron knees, to extend 5 feet passing diagonally. The height under cabin beams 7 feet; the height of the deck beneath the above, to be 7 feet; between the beams to be beamed and kneed and fitted with stringer, the same as that of the cabin sole, 3½ feet space, except the beams, which are to be of Dantzic fir.

Fore Cabin Beams.—Forming fore cabin soles, oak; the same scantling as those aft, and similarly secured; height of fore cabin, 7 feet between the beams; three feet space. (Stern beam, see below.)

Clamps.—African or English Oak. To have two strakes, each 6 in. thick, 12 inches broad, to be reduced forward and abaft to 4 inches thick, and 9½ inches broad; to be scarphed back and butt, and bolted together at the scarphs edgewise, and, in addition to the trenail fastenings to have bolts at about 3 feet apart, to have two strakes under the shelf piece of the after platform or cabin deck, 4 inches thick, African or English oak, diminished abaft to 3 inches thick; 12 to 9 in. broad each; ditto under the fore platform. Under these clamps, to have two strakes, each 3 in. thick, 10 in. broad, of African or English oak; the remainder of the ceiling to be Dantzic fir, or red pine, 3 in. thick.

Upper Deck.—Water way, Dantzic fir, or red pine, 6 in. thick; flat of the deck, Dantzic deal, 3 in. thick, and copper-nailed. Partners for masts, gammoning chocks for bowsprit, steps for masts to be of oak, and well secured.

Quarter Deck.—Breast rail and stantions to be wood. Waterway, Dantzic deal, 4 in. thick; flat of the deck, Dantzic deal or pine, 3 in. thick, copper-nailed or fastened on the edge, and dowelled.

Platform for Cabin Decks.—Red pine. Iron-nailed and caulked, 2½ in. thick.

Deck under aloon Ssole.—Seven feet beneath the floor of the saloon; another deck to be 7 feet in the clear of beams, to be iron spiked and caulked, and planked with pine 3 in. thick.

Forecastle.—Five feet high from deck to deck; to extend 14 ft. abaft the stem; to be supported by three Dantzic beams, 10 in. moulded, 8 in. sided; and one at break, 12 in. by 10 in., fastened by two iron knees at each end. The beams to be supported by a fir stringer, 8 in. moulded, 6 in. sided; to which the beams are to be coaked and bolted, and to be secured each by two iron knees at 5 feet space; deck 3 in. in diameter, nailed as main deck. Hawse trunks, leading from hawse holes to main deck for the cables. Bulk head 1½ in., fitted with a door at each side to form a store room, and to have berths for sailors as required.

Fore Cabin Soles.—From the bulkhead before the engine-room, a deck to run all the way forward 7 feet high between the beams, a portion of which to be fitted up as a second cabin, and about 16 feet in length from the stem, a place to be fitted for the sailors' floor; iron nailed and caulked, pine, 2½ in. thick.

Main Deck.—Dantzic, 6 in. broad, 3 in. thick. Nailed with composition nails 15 lb. to the hundred, double-nailed at every beam, and at every butt end, single-nailed at every carling.

Breast Hooks.—One to the upper deck, of wood, 144 in. long, and sided the same as the beams are moulded. Three of iron, one weighing 4 cwt., and the other two weighing 2 cwt. each, to be securely bolted and clenched on rings.

Diagonal Oak Chocks.—To be placed under the stringer at each oak beam of the upper deck, to run down to the stringer underneath, having its face to range with the face of the stringer, on to which diagonal iron knees sufficiently long, 2½ by 3½ in., tapered to 1 in. and 4 in. in the throat, are to be fitted, and bolted through these chocks and the sides with ⅞ in. bolts, and also through the beams aforesaid, and clenched on rings; similar chocks to run from each of the lower deck beams to the turn of the bilge, with the same kind of knees, and secured in the same manner.

Diagonal Iron Plates.—To be laid at the angle of 50° to 60° from the keel, ¾ in. thick, 4 in. broad, to be scored into the timbers, and to run down 2 feet on the floors from within 2 feet of the upper stringer, four feet space, to be bolted through every timber with copper and iron bolts ¾ in. in diameter, to extend the entire length of the vessel.

Sponsons.—To be fiddle-shaped, and carried out six feet beyond the frame, leaving an open space for a wheel 25 feet diameter, and ten-feet floats. The spring of the after sponson to commence at a distance not lower than 1 foot above low water line.

False Sponsons.—Oak. 7 in. moulded, 5 in. sided. Each timber bolted through at its head and its heels, and clenched. Dantzic plank, bolted at each end, 3 in. thick; felt to be put at the points of junction between the sides and the false sponsons, and firmly bolted.

Rother.—At the head, 14 in. athwart, 16 in. fore and aft. To have mixed metal braces and pintles; to have a spare tiller and rother chains properly fitted.

Windlass.—With purchase wheel, paul bitt, riding chocks, metal whelps, range head, cross rail, and belfry complete, 19 in. diameter; at the ends, 17 in. diameter.

Paul Bitt.—To run down and bolt to the beams below, 14 in. square. To have a standard against it upon deck, if required.

Carrick Bitts.—6 in. sided, 20 in. moulded.

Cat Heads.—To be fitted with shivers, 12 in. sided; 11 in. moulded.

Fish Davit.—At the heel, 6 in. square; at the head, 5 in. square.

Steering Wheel.—To be mahogany, 5 feet diameter; to have a steering quadrant, with iron bolts and chains complete.

Bulwarks and Roughtree Rail.—Stantions in the wake of the rigging, and before it, to be oak, 7 in. by 5 in., without any outrake. Timbers to be run up from the framing to form ports for three guns abaft and two before the paddle boxes on main deck, and for two on each side on quarter deck; opens of 3 feet wide by 2 feet 8 in.; timbers, 7 in. by 5 in.; space of timbers, 20 in.; stantions for man rope round forecastle.

Roughtree.—From fore gangways aft, elm, 3½ in. thick by 7 in. wide; the port stantions to be fitted with ring and eye bolts for guns, and the open to be provided with ports, fitted on hook hinges. Gangway doors as required.

Coming,—upon deck to be 9 in. deep, and 4 in. thick.

Timber Heads.—To have four on each quarter, and two on each bow, for securing the ship by hawsers or chains; to have cast-iron casings.

Deck Houses.—To extend 20 feet before and 20 feet abaft the paddle boxes; to have oak sills or comings, 9 in. by 4 in., let down on the beams, and bolted to them and clenched; front stantions 7 feet 6 in. high at the paddle boxes, diminishing to 6 feet 6 in. forward and aft. Roof-timbers, oak, 3½ by 3 in.; spaces 3 feet, to round off from the outside at one foot above the rail; to be let in through the rail, and bolted; the scarph of the roof-timbers to be secured to the front stantions with iron plates, bolts, and screws. Stantions, oak, 7 in. by 5 in., to 5 by 3½ in.; the roof to be 1½ in. pine, to be ploughed and tongued, painted. Stripes of 20 oz. copper to be nailed round the outside and inside edges of the deck houses and paddle boxes, with composition nails. The houses to be fitted up inside with moveable cot-frames, sleeping-berths, and other conveniences, as directed; each with a neat pannelled door and glazed window; inboard planking, 1½ in. Dantzic, ploughed and tongued, and neatly battened in pannels.

Cabins, Forward and Abaft, and upon Deck, and Steward's Pantries.—To be fitted up in pine timber, in the best style of workmanship, with 150 sleeping berths, if required; each berth to have a moveable cot-frame and water-pot box. Should mahogany in any case be preferred in the cabins, it is to be furnished by the owners, and worked by the builder, according to directions, without any additional charge, the owners finding all locks, hinges, screws, and brass work, side and deck lights, and the builder to fit them in as required. Lockers in saloon to form seats, as required.

Seats for Quarter-deck.—To be fitted by the builder, hung with hinges, and supported by swinging brackets.

Ladders.—A gangway ladder at each side, with fall-down platform, to be each supported by an iron swinging frame; all fitted with rails and stantions complete. Ladders leading to quarter-deck, forecastle, hold, and engine room; all the sides and platforms to be of oak.

Framing of the Deck over Engine Room and Boilers.—A space of 10 feet wide and 30 feet long to be left for boilers. Two pieces of African oak, 13 in. by 11 in., to extend from the beam immediately before the boiler room to that in front of the main hatch, from which lateral oak beams are to extend to the sides, which are to be kneed with light iron knees and dog bolts, and to the fore and aft bearers. The deck framing to be done according to a deck plan to be furnished by the engineers; properly framed with carlings and half bearers. Those between the paddle beams to be oak, 6 by 8 in., one round bolt 2½ in. diameter on each side, to extend from one paddle beam to the other, passing through and through the intermediate beams and carlings, with nuts and screws to each end, to connect the entire into one.

Head.—To have a neat carved figure-head with checks, rails, and carved trail-board; the front of the knee above the copper to be covered with plate-iron.

Stern.—To be square, about 30 feet wide, with carved taffrail, trusses, and drops. To have stern lights fitted with sashes and dead lights.

Quarter Galleries.—To be false galleries or bridges on each side, ornamented with carved works; the top to be covered with sheet lead.

Taffrail Rail.—To be English elm, 4 in. thick, well secured to the stern timbers.

Scuppers.—As may be required.

Bill Board,—for the anchors to be elm; to be covered with plate-iron over the rail.

Metal Chocks,—with double iron rollers, one on each bow and quarter.

Paddle Boxes.—To be covered with two-inch ploughed and tongued deal, lined fore and aft withinside with ¾ in., the two main stantions to be 12 by 8 in.; the rest in proportion; well secured; a lead cistern to be fitted to each side, with conveniences for catching water from the paddle wheels to supply the water-closets.

Gangway.—A gangway or bridgeboard fitted up with iron stantions, to communicate from one paddle box to the other; steps to be fitted to ascend the paddle box.

Spring Beams, to support the paddle shaft. African oak of sufficient depth and thickness, well secured as may be directed.

Engine-room Bulkheads.—To have a double bulkhead abaft the engine room stantions, 12 by 4 in.; planked with 2 in. poplar, ploughed and tongued. The space between bulkheads to be filled with sawdust. Door or scuttles to be fitted to mud holes. The bulkhead before the engine room to have oak stantions 6 by 4 in., four feet apart; the plank to be two inches thick, ploughed and tongued. A bulkhead to be built from 10 to 12 feet before the last mentioned, of similar materials and workmanship, for the reception of coals.

Fore cabin bulkhead to have oak stantions 6 by 4 in., four feet apart, to be planked with 2½ in. pine, ploughed and tongued. The bulkhead for engines and sailors' berths as required. Galleries or

platform to be fitted in the engine room, for the engineers to inspect and attend to the upper part of the engine, firmly supported and connected by iron brackets, and laid with gratings or two inch pine: to have berths for engineers, firemen, and coal trimmers as may be directed.

Iron Works.—All necessary for completing the vessel in the hull, masts, and yards to be provided by the builders, such as hoops, rings, and eye-bolts, and all other bolts, chain plates, rack and belaying pins, hatch bars, sky light and crank hatch gratings; four cranes or davits for the quarter boats, and two stern davits, stantions for quarter nettings and forecastle, stantions for quarter deck, ladders for engine room, standard bowed iron for hoisting up ashes, eight deck ring-bolts with indented metal sockets, and two metal sockets fixed in the deck for the chain to reeve through.

Copper.—The vessel to be copper-fastened from the under part of the weals to the keel. The bottom to be sheathed with copper upon tarred paper, with 28 oz. and 24 oz. up to 14 feet in midships, and up to 15 feet forward and abaft. The 28 oz. to reach 3 feet down from the upper part.

Winch,—at the fore hatchway, with purchase wheel and working barrel, with ends complete; similar to those fitted in the City of Dublin Steam Packet Company's vessels.

Pumps.—Four leaden or iron pumps with brass chambers, and brass boxes, six inches bore, with gear complete.

Plumbing.—Six patent water closets, 4 abaft and 2 forward, with all necessary pipes and cocks for carrying and discharging salt water, and fresh when required; with a leaden cistern for fresh water, to contain 100 gallons, to be fixed in such place as shall be pointed out. Cistern for salt water on each paddle box to contain 40 gallons each, with eight wash basins and all necessary plumber's work for completing same, and steward's pantry, with requisite pipes and cocks, &c., two common necessary places for ship's crew forward, with leaden pipes to carry salt water from paddles.

Painting.—All the cabins, forecastle, ship's sides, deck houses, all works finished by the builders and usually painted, including the masts and yards, to have three coats of good oil common color. All brass work, framing and gilding, to be done at the owners' expense.

Glazing.—All lights to be glazed with the best crown glass; all plate glass, if any required, to be found by the owners.

Masts and Yards.—The builders to supply masts and yards complete, with martingales, ensign staff, and jack staff, the owners agreeing to pay one half the expence thereof.

Water Indicator.—The vessel to be fitted with tubes forward and abaft, with a scale on each, shewing the draught of water.

Chain Cable Lockers.—To be fitted as may be required.

Caulking.—To be well performed, and the oakum to be of the best quality; the seams between the floors and futtocks to be caulked and pitched within and without, as high as the upper turn of the bilge. Bottom and sides to be caulked and paid.

Trenails.—Best English, Scotch, or Irish oak, well seasoned; their ends split after being driven, and caulked.

Bolts and Spikes,—passing through beneath the load water line, or fourteen feet draught of water, to be of copper; those above to be of iron; all bolts to be driven through and clenched on rings; where not specified, to be of size proportioned to the timber.

Stern Beam.—At upper deck, oak, 10 in. by 12 in., to be coalked into the stringer, and staple iron kneed to the beam before it, and bolted to the stern timbers. Beams at cabin sole, as well as that beneath it, to be oak, 8 in. by 10 in., secured as above.

Stantions.—One under every beam, except those in the cabin; oak, 6 inches.

Quarter Deck Breast Rail.—Elm, 7 in. by 3 in., with oak turned standards, 4 inches.

Side Ports,—and side windows under quarter deck to be fitted as required.

Companion—to after and fore cabins, and to engine room and sailors' cabin, with ascending stairs, doors, &c. Skylights for fore and after cabins.

Inspector or Overseer.—The owners to have the appointment of a qualified person to approve of the materials and workmanship, and in the event of a difference of opinion touching any of the details of this specification, or as to materials or workmanship used in the execution of the work, the same to be decided by arbitration by persons mutually agreed on, who are to decide finally.

Timber and Plank—used in the construction of this vessel to be of British oak, excepting where otherwise specified, and the whole to be of the first quality, and to be wrought free from sap, shakes, or defects, to the satisfaction of the inspector; and if any defective materials or bad workmanship be put into the said vessel, the same shall be taken out and replaced at the builder's expence. The whole of the materials for building and completing this vessel, in hull, masts, yards, in every respect as required by this specification, to be provided and fitted up by the builders, (half the expence of masts and yards to be paid by the owners), and shall be of the best description, and executed in a substantial, workmanlike manner, to the satisfaction of the owners or of the surveyors appointed by the owners to inspect the same, and shall be equal in quality of materials and workmanship to that of any other vessel.

BIOGRAPHICAL AND CHARACTERISTIC SKETCHES, OR CONTRIBUTIONS TO ARCHITECTURAL BIOGRAPHY.

SIR ROBERT SMIRKE.

WHATEVER be our opinion of the maxim "De mortuis nil nisi bonum"—and it is one that does not very much encourage honesty and plain-speaking in a biographer—it does not restrain us from freely expressing our opinions, on the present occasion, our subject being still a living one—though one, we suspect, who has outlived the reputation he formerly enjoyed. Truly can we say that it would give us unfeigned satisfaction to be able to affirm that such reputation was not at all beyond his real desert, for he has done so much, has been so favoured by opportunities, and has erected so many large structures, that most delighted should we be could we point to them as being great also—great as architectural achievements and as works of art. Yet in every thing he has done, even the very best, there is always something exceedingly cold, insipid, and unsatisfactory,—no evidence of artistical spirit or feeling, much less aught approaching to genius. To have said or even hinted as much, many years ago, would have been considered, if not exactly high treason, little less than deplorable architectural heresy; for in those days, architectural criticism hardly existed; or if it did, there was no channel through which it could reach the public. Even government patronage was then a monopoly enjoyed by one or two architects, who were in a manner perfectly irresponsible to public opinion, and autocrats in their own department. In individual

cases, such private irresponsibility may be for the public benefit as regards the advancement of art, for then genius is left to do justice to itself, to follow out its own ideas and impulses, instead of being thwarted by busy-body interference on the part of those who have not an idea of their own, except a few cramped schoolboy notions which they have picked up. As a system, however, the one alluded to was bad—positively injurious and mischievous, as is now but too well proved by the effects resulting from it during the reigns of the two last Georges, when Wyatt, Soane, and others, played their fantastic pranks, as disgraceful as they were costly to the country. Competition for public works was not then to be thought of: it would have been considered an infringement on the rights and interests of the privileged few; and badly and unsatisfactorily as competition has in almost every instance but one been managed, we cannot help thinking, that if it has not up to the present time done all the good which might have been effected by taking more judicious measures in it, it has abated some evils.

The mention of competition brings us once again to our professed subject, since it leads us to remark, that Sir R. Smirke has uniformly been opposed to it; and has never in any one instance, we believe, been known to enter into any competition, however limited it might be. On the contrary, he has kept aloof from every thing of the kind,—no doubt very dignifiedly, but with a dignity bespeaking excess of caution, instead of ardour and courage, or even a decent confidence in his own powers; and so far he may fairly be acquitted of any overweening conceit and vanity. Neither is this the only matter in which he has pushed his reserve too far, and kept himself to himself, as the saying is, but he seems to entertain as great horror of exhibiting as of competing along with others. Notwithstanding that he is a Royal Academician,—one of the two, or perhaps three in the profession, who can attach the imposing letters R. A. to their names, never have we once, during the many years we have been in the habit of attending the Academy's annual exhibitions, seen a single design of any kind by him, or his name in the catalogue, except in the list of the members. Indeed, he has made himself so remarkable by his continued absence, that he might very well be allowed also to assume the letters A.M., as the Absent Man or Absent Member of the Academy. We do not say that we have lost any thing by his system of non-exhibition, for we think it rather a pity it cannot be extended to all or nearly all the buildings erected by him. Still, there is something illiberal and narrow-minded—if we may so venture to speak it out—something ungracious at least—in invariably withholding—we do not say his *might*, but his *mite* from his brother academicians. It betrays a sort of dog-in-the-manger feeling, a desire to keep others in the profession out of an honour which he himself seems to despise; and which, doing nothing in return for it, he would do well to resign; and had he never accepted it, he would at least have escaped all comments of the kind here made.

For indulging in such comments we offer no apology, because we think none required, or rather that it would be sheer paltry affectation on our part, feeling that there is no indelicacy in animadverting upon what is self-notorious. An artist, *quoad* artist, is a public character, and his merits or else his pretensions may accordingly be discussed with the same freedom that those of other public characters are. Besides, at all events, it must now be matter of perfect indifference to Sir Robert, what opinion either ourselves or any one else may express concerning him, since it cannot touch him in what, for aught we know, is his most vital part—his pocket. He has not now to make his way in the profession; our praise, were it ever so extravagant, could not help him on a step farther in it; neither can our censure retard a professional career now apparently terminated altogether. We confess it may be said in answer to one observation above made, that after all Sir Robert is no *artist*, nor do we pretend to assert that he is. And if so, it may be asked, why we consider it worth while to bring him forward at all, or bestow any notice upon what he has done; to which we reply, for two reasons: first, to show how a man may be pushed on by mere good fortune and favourable circumstances, while far superior talent may not have even a single opportunity afforded of emerging into notice; and secondly, to make evident what sort of dull, common-place stuff the public have received, or, in their excessive innocence, have allowed to be passed off upon them, as "classical" architecture.

With the multitude, who have no other standard than that of size and quantity, it is easy enough to make Smirke pass for a very great architect indeed, it being undeniable, that in the metropolis alone he has erected a great many buildings, and some of those none of the smallest. That he should have been employed on so many, is to ourselves the most astonishing part of the matter: instead of displaying any sort of imagination or fertility of ideas, they serve by their very number to make more evident than otherwise would be, the barrenness and poverty of both. All that was in him he showed at first, nor has he advanced a single step further throughout his whole career. Almost all his buildings have a strange poverty-stricken look; he has no other idea of simplicity than that of naked baldness, or of classical design than sticking up columns mechanically copied or manufactured according to the usual routine recipes known almost to every stone-mason, who could *design* such things quite as well, perhaps even better. At the very best, the merits of his buildings are merely negative ones; there is nothing glaringly absurd or offensive in them, because they are common-place, and made up only of the crude generalities of a Greek order, applied indiscriminately on every occasion. Our architect had got his lesson by rote at first, and has afterwards gone on repeating it with no other variations than a few transpositions of the same features, without reaching a second idea. In all that he has done, it is impossible to detect one, or even the glimpse of one; and equally impossible is it to discover any study bestowed upon detail, or any sort of finish, or any consistency of character. Most certainly, there is neither variety nor individuality of character in any of his buildings; which, as far as they possess it at all, do not derive it from design, but from circumstances purely adventitious. In fact, they have either no distinct character at all, or else such as is at variance with their actual purpose. Covent Garden Theatre has very much more the air of being intended for a Mint, than the Mint itself, erected by him on Tower Hill; which, did it stand in Pall Mall, might very well pass for being a Club House, and certainly quite as tasteful a one as his sulky-looking Conservative one, or that other dowdy piece of "classical" architecture by him called the Union, a jumble of ill-assorted would-be finery and meanness, unequalled in bathos, except it be by that other precious architectural specimen—the Oriental Clubhouse, by the Wyatts. What the façade of the British Museum will turn out, we know not, except that it is likely to prove a common-place string of columns, and nothing further; but in regard to all the rest, as far as now completed, the exterior of that national edifice looks much more like a warehouse, or something of that kind, than a

Museum. As to the Post Office, again, it has certainly no express character, nor indeed any thing good about it, except the portico; which, taken by itself, is unexceptionable enough. Yet it also affords a striking proof how utterly unable Smirke is to catch a new idea, even where it would seem to be almost thrust upon him; for had he here combined the portico and hall, making the latter and its colonnades a continuation of the former, and substituting a single large door for the very unclassical arched doors and arched windows over them at the farther end, a very striking degree of effect, and strongly-marked character might have been produced. At present, the hall itself is mere hotch-potch as to design; it has Ionic columns, and has nothing else whatever, either Ionic, or Grecian at all, about it. The windows behind and over the columns, are as mean, paltry, and ordinary, as those for a kitchen or servants' offices. His specimens of Gothic and other buildings in the Temple, are truly wretched, the former more especially; for they only show that he is altogether ignorant of the principles of design in that style. Therefore it is no satisfaction whatever, rather all the greater mortification, to know that they are constructed of something more durable than mere lath and plaster work. What he has done at the Custom House, is certainly no improvement upon the original design, for it has quite destroyed what was the only tolerable and characteristic portion of Laing's structure. Of King's College, the very least that is said the better; the mantle of Sir William (Chambers) most assuredly did not fall upon the shoulders of Sir Robert; it is therefore rather curious that the two should have been brought into such close juxta-position as they are by their respective buildings in Somerset Place. Look at the two picturesque gateways by Chambers, and then turn to the frigid piece of insipidity which forms that leading from the Strand to the College, and avoid shrugging your shoulders if you can. We recommend the comparison as an excellent study.

The above constitute but an inconsiderable numerical part of the buildings on which Sir Robert has been employed during what we suppose must be called his *successful* career. Yet even these few, or almost any single one among them, might have sufficed to a man of real genius and mind, to produce a masterly and artist-like work. Truly mortifying indeed is it to reflect, that while a man of so much taste as the late —— Parke had not a single opportunity afforded him of realizing any of the happy conceptions and beautiful ideas displayed in his exhibited drawings, opportunities should have showered down upon one, upon whom they have been flung away; opportunities golden in themselves, but which he has converted to lead, or at least has availed himself only to put the gold into his pocket. With that gold he must now console himself, as no doubt he does. For fame he has very evidently not striven; and such being the case, he will feel no disappointment at having missed it. We do not however pretend to say, that Sir Robert's name is likely to be soon forgotten after his death; therefore, if to be remembered be fame, he may promise himself a tolerable long lease of it. Had the earthquake kept its promise, some of his offences might perhaps have been blotted out from recollection; or were every thing he has done to be now swallowed up, he might then have some chance of his name passing with posterity, as that of the eminent classical architect of his day.

ECONOMIC GEOLOGY.

In a paper relating to this subject, inserted in the number for December last, p. 249, intitled "Considerations on the universal importance of Practical Geology," we announced our intention of extending a similar series of observations to other districts of country than the one there chosen to illustrate the importance of economic geology. In pursuance of this design, the present paper may be taken as a continuation of the one referred to; but it should be observed, that in future we shall not confine our observations to particular districts, thus proceeding throughout the whole of England, but shall rather adopt, as heads or divisions of the subject, certain of the most important earths or constituents of the earth's crust, and describe the localities where they exist in connection with the uses and employment of these earths in the arts and manufactures of the present day. Such an arrangement has several advantages over a series of merely physico-geographical descriptions of particular limited districts. In the first place, it permits one with less of apparent incongruity and less of real confusion to introduce many collateral examples, of more or less importance, to show the employment and adaptations of the earths in question in other parts of the world. And secondly, it interferes less with the labours of the topographer, the geologist, and the writer of physical geography, all of whom necessarily fix upon districts whose limits are either natural, purely arbitrary, or political; and adopt the style of describing in detail the productions and constituents of the tract within such limits.

In carrying out the object here proposed, of bringing together into one connected series the economic uses to which the principal earthy minerals are applied, we venture to express our opinion, that something will be thus effected towards the connection of the physical sciences with each other. It is impossible in a general history of any mineral to avoid some mention of its use by many separate artists and workmen; thus, taking either sand, clay, or lime, what an astonishing variety of trades and occupations are there which require a knowledge of these minerals to teach them their right employment, their proper use, and their true value. Let it not be imagined, because this Journal is headed with the names of three specific professions, that no department of the useful arts or the physical sciences ought to be consistently introduced here except what immediately relates to one or other of these professions. It is true that we may refer to processes in the arts and to manufactures of the earthy minerals, which neither an architect, an engineer, nor a surveyor may ever be called on to practise as a part of his profession; and yet we hesitate not to say, that to all of these professions an intimate knowledge of the uses and adaptations we have spoken of, will be found an useful and important acquisition. The surveyor, for instance, if he would hope in these days to distinguish himself in any degree, or indeed to obtain employment of his time and talents, must be something more than a mere measurer of land and houses. Men of the latter class, that is, mere drudging, working surveyors, who plod over the land with their chain, and field book, and clodhopping boots, and know no more of the soil, nor its capabilities, than the jackdaw on the neighbouring tree, are not of the kind likely to rise in these days of enterprize and industry. Such men are as plentiful as hips and haws, and not much more useful. But all this is far from being as it should be. Agriculture is undoubtedly the kindred science most allied to the business of a land surveyor, and the necessity of devoting attention to it, is not unfre-

quently forced upon him when he attempts to unite the practice of valuing land with that of merely measuring it. Once admitting that agriculture should be studied and somewhat understood by the surveyor of land, the way is paved and the path is open to many sister sciences, highly useful and important. Thus, something of chemistry, something of botany, some knowledge of the arts of pottery, and many others in which earths and minerals are employed, will be any thing rather than useless. Indeed, if we reject all but the simple supposition that a man is to set a value upon land, which value involves not only the profit it has hitherto yielded, but what it may in future be made to yield, there can be no hesitation in assenting to the necessity of understanding the varied and extensive capabilities and applications of all the soils and subsoils of the land he may be required to value.

To the architect, who is constantly employing all kinds of stone suitable for building, and racking the whole mineral kingdom for new and useful varieties of building stone, who is constantly employing cements and mortar, and sand for mixing with lime to form the latter, who is constantly directing the manufacture and the choice of bricks for his edifices, what can be more important than the kind of knowledge we are here speaking of. Clays suitable for the most exquisite wares of the potter, would make very inferior bricks and tiles; sandstones capable of bearing the most intense heat, would be most injuriously acted upon by moisture. Fuller's earth, a substance of great value in the woollen manufacture, and hardly distinguishable in appearance from common brown or yellow clay, possesses in reality properties entirely at variance with those of clay, and would be quite unfit for every purpose to which the latter is applied.

But if a knowledge of the mineral characteristics of all strata be of importance to the architect and the surveyor, how much more necessary is all such knowledge to the engineer. The difficulty in his case is not so much that of showing what and which department of physical science is most intimately interwoven with his labours, as that of pointing out what single department, or branch, or subdivision—nay, more, what single isolated fact—in all the wide domain of nature's history is unimportant, uninteresting, or useless for his purposes. The man who wields the sources of power in nature! What a splendid attribute is this! how much of majesty in these simple words. The lofty aim of the engineer is none other than to realize an undivided dominion over the whole material world. For this he subdues the elements—for this he seizes upon the motive powers of fire, and air, and water; applying them in a thousand varied forms, and to as many different purposes. The whole history of the engineer's triumphs over inorganic matter is made up of a continued series of applied natural facts, and wherever we find an engineer distinguished above his brethren, and particularly wherever we find one who has originated some great improvement in the resources of his country, we find him at the same time remarkable for accurate observation, and extensive acquaintance with natural history. Such was the celebrated and respected Mr. Telford, such was his friend and former pupil Mr. Nimmo, and the same may be said of Rennie, Whitworth, Smeaton, and a host of others who first represented the profession of the civil engineer in this country. It would be invidious to mention living names, and in some degree unnecessary; for who is there who cannot verify the truth of what we are contending for, by his own knowledge of some one or other of the eminent men who now stand at the head of the profession.

Considering, then, that not one or two, but all the branches of natural history should enter into the education of an engineer, it will at least be admitted, that none are of greater importance than a knowledge of the mineral structure, the characteristics, and economic uses of the numerous kinds of earth with which he is so largely concerned. Conceive him executing any great earth work, as a road, a canal, a railway, a dock, or harbour; and no one will dispute that he ought at least to possess as much knowledge of all the strata penetrated in the course of the enterprize, as any other person can boast of. He is *obliged* to fix upon the clays proper for brick and tile making, and for puddling; upon the sand proper for mixing with mortar, and upon the lime and cement stones proper to be used in different structures. All this, however, is mere surface knowledge—it is in fact what every engineer is obliged to know and practise—but the acquaintance with practical economic geology which we are here advocating, leads him much farther than this. It would prevent him from overlooking or perhaps from burying up entirely valuable mineral beds which might pay ten times over the cost of excavation; it would enable him to see many different uses to which these beds could be applied, which without such knowledge he would never think of; and very possibly it might lead to great improvements in the employment of many earths for purposes purely engineering and architectural.

EXTENT AND ORIGIN OF SAND AND SANDSTONE.

If we consider the immense plains and mountains of sand spread over the deserts of more than one continent, the vast accumulations of sand in the beds and valleys of rivers, and in the basins and on the shores of seas all over the world, and, moreover, the great proportion of sand which enters into the composition of all freestones, sandstones, and even of granite, and of many limestones, we shall probably not exaggerate in classing at least two thirds of the whole crust of the earth under the general head of sand, or sandy materials. The composition of arenaceous rocks, and the general origin of these vast accumulations of sand, present to the student of natural history as interesting a problem as any in the wide range of physical geography. Arenaceous rocks, according to some geologists, are composed of grains of sand agglutinated and cemented together; and we are also told, that all the loose or uncemented sand scattered over the face of the earth has been derived from the destruction of arenaceous rocks. Hence, we are led to inquire whether these ancient rocks which have been destroyed were in their turn composed of sand previously existing in a loose state, and if this sand again was at a still remoter period one of the constituents of still more ancient rocks. To these inquiries the general answer would appear to be, that a succession of alternate constructions and destructions of a great mass of the earth's crust seems to have taken place through the lapse of innumerable centuries; and while speculation may extend the number of such changes to infinity, no landmarks appear to guide the judgment in fixing either upon their order, their number, or duration. Another theory accounts for the formation of sand, by supposing that the grains have been directly crystallized from pure silica; but, however this may be with respect to some accumulations of sand, and some quartz rocks which undoubtedly bear marks of crystallization, it certainly cannot apply to arenaceous rocks containing fossil remains, nor to a very large mass of arenaceous deposits belonging to the secondary, the tertiary, and post-tertiary periods. It is due, however, to the researches of

Romé de l'Isle, the principal geologist of note who has made observations on this subject, to admit that he has proved by accurate examination of the grains under a high magnifying power, that many strata of very fine white, and very pure, siliceous sand are not produced by the trituration of other rocks, but have been formed by chemical precipitation. He found that those minute grains, which appear so round and smooth to the naked eye and to the touch, are in reality perfect crystals, bounded by numerous facets or minute planes, which only the aid of the magnifying glass could enable him to discover.

All geological formations from the new red sandstone upwards, if we except the lias and the chalk, contain interposed beds of sand, in a loose, or at least in a very imperfectly indurated condition. The grains of sand in these beds are mostly of the rounded form, and they are always more or less ferruginous. Thus the red and reddish brown sands of the lower oolite, of the Wealden, and of the plastic clay formations, owe their colour principally to the red oxyde or protoxyde of iron. The green-sand formation is distinguished by the occurrence of numerous green particles composed of silicate of iron, and resulting from the combination of this metal with portions of silica and alumina. Notwithstanding, however, the name of green sand which has been bestowed by geologists upon a particular formation underlying the chalk, the colour of green is by no means to be understood as that prevailing in the beds of this sand. These beds are, in fact, usually of red, brown, and white sands, and where they become indurated, the cementing matter is commonly calcareous, as in the firestone of Reigate and Merstham in Surrey, and in the Kentish rag of Boughton and Sutton Valence. Amongst the sand of this formation also, and particularly in the beds of the firestone, are disseminated numerous small plates or spangles of mica, which impart a glistening or shining appearance to the stone. The firestone is a substance universally known as the common hearthstone, so much in use in every direction around London for cleansing hearths, steps, and flag stones. Its more important use is that of lining the interior of ovens, lime and brick-kilns.

The sands of those vast deserts which in Asia cover so large a portion of Arabia, Persia, and Hindostan, are supposed, as well as that of the great desert of Sahara in Africa, to have been derived from the destruction of immense ranges of sandstone rocks. The sand of Arabia is red and coarse, containing much iron, the oxydation of which has probably aided in its decomposition.

The continent of Europe affords many examples of dunes or sand hills, which consist of blown sand brought down originally from the elevated regions in which they have their source, and which, being left dry on the flat beaches around their embouchure, are transported by the wind, often to the serious destruction of fertile lands. Most of the rivers which flow into the Bay of Biscay on the west coast of France, as the Adour, the Garonne, and the Loire, have in this manner been instrumental in producing dunes of great extent on the sea shore, and for many miles inland. Projects for preventing the accumulation of these sand-hills, and for checking their distribution over cultivated lands, have engaged the serious attention of the French Government, and much benefit has been derived from the zeal and ability with which their engineers have devoted themselves to the perfection of these projects.

Large districts of country on the continent of Europe consist of sand derived from the decomposition of granite, to which parent rock their origin may be readily traced. Thus in France the sandy tracts of Lozere, of the Puy de Dome, of the Cantal, and of Loire, have obviously been formed by decomposition of the great range extending through the provinces of Cantal and the Puy de Dome. The sand districts about Alençon have been similarly derived from granite, and those of the Vosges from the great chain of mountains which separates that department from those of the Upper and Lower Rhine.

When sand is indurated into stone, the cement which unites the grains is either calcareous, siliceous, or ferruginous. The former of these is readily acted upon by all acids, so that all sandstones with a calcareous cement may be reduced to grains. Such stones also, when exposed in buildings to the alternations of a variable climate like that of Great Britain, are much liable to decomposition, as the part of the stone related to lime is always susceptible of imbibing moisture from the atmosphere, which moisture, when acted on by frost, expands, and causes the stone to break, or at least to scale and peel off on the surface. The ferruginous cements are also objectionable, as they are liable to oxydize, and to waste away from the body of the stone, leaving the earthy grains almost without adhesion. There are indeed examples of stone in which, when taken from the quarry, the cementing material has been found entirely destroyed by external causes, and the grains, scarcely adhering together, present a kind of cellular, or honey-comb, or perfectly porous texture. The siliceous cement is the only one of the three which can be safely depended on for resisting a constant exposure to atmospheric phenomena; and although neither this nor any other composition, whether natural or artificial, will last for ever, it forms undoubtedly the kind of stone which should ever be sought for when great durability is required. The sarsden stones, or grey weathers of Salisbury Plain, and the sandstones found in other parts of England above the chalk, consist of grains united by a siliceous cement. It is highly probable that these grains have never been worn or rounded by attrition, but deposited at once in the form of silica. It is true that they are commonly round, but this arises from hasty crystallization.

M. Saussure describes a remarkable instance of the modern formation of sandstone, which he had himself witnessed on the shores of the Mediterranean Sea, near Messina. He observes, that the sands which on some parts of the coast are moved about by the waves, receive, in places where the water is more tranquil, an infiltration of a kind of mucous calcareous matter which the sea-water leaves upon it, and which in time cements the sand so firmly together, that blocks of it when taken up are found hard enough to be used for mill-stones. This fact is known at Messina, where the inhabitants are constantly carrying away the stones thus formed, and the sea shortly after filling up the hollows with new sand, this in a few years becomes so firmly cemented together, that the stones of this very recent formation cannot be distinguished from the true sandstones of quarries.

EMPLOYMENT OF SAND IN THE MANUFACTURE OF GLASS.

When a siliceous substance is mixed with a due proportion of alkaline matter, and exposed to an intense heat in a furnace, a fusion of the mixture takes place, and the fluid mass, which is formed in this way, becomes, when solid, the clear, transparent body so generally known under the name of glass. Window glass is distinguished, according to its size, under the name of plate glass, crown glass, sheet glass, &c.

Fine sand is the siliceous material most extensively used in the manufacture of glass, although pounded flints, and pounded glass

itself, are also made use of in certain proportions, to form the siliceous mixture. The best kind of sand for the glass-house is that which contains the greatest quantity of minute transparent quartz crystals. The white sand of Reigate has been extensively used; but is probably not superior to that brought from Dersingham near Lynn Regis, on the Norfolk coast, and from Alum Bay in the Isle of Wight. The latter locality is on the plastic clay formation; the two former belong to the green sand.

The proportion of silex employed in the composition of glass is very variable: at some works, and for some kinds of glass, not exceeding one-fourth of the mass: and at other places, and for different kinds, constituting two-thirds of the whole bulk. It appears from accurate experiments made in France, that a pure alkali, mixed with a perfectly pure siliceous sand, will cause its fusion, when the proportion of the alkali to the sand is no more than 1 to 4; but in most of the works in this country, a greater quantity of alkali is made use of. The alkali formerly used for producing fusion of the silex, was obtained by burning the sea-weed called kelp into ashes. The ashes, being then pounded, were mixed with the sand, after the latter had been thoroughly cleansed from all saline and other earthy matters, except the pure silex. The preparation of kelp for the glass-works furnished employment at one time for many persons in the north of Scotland, the Orkney Isles, in Ireland, and the Hebrides; to which, however, the modern substitution of the carbonate of soda instead of the pounded ashes of kelp, has almost entirely put an end. Common bottle glass is made from sea or river sand, mixed with soap-boilers' waste, in the proportion of three of the latter to one of sand. Inferior window glass contains commonly four parts by measure of sand, to three parts of kelp ashes, and six parts of soap-boiler's waste. The materials for crown glass, which is the name given to the best kind of window glass, are three parts by weight of fine white sand, to two of soda and two of broken glass. Flint glass or crystal was formerly made from the powder of calcined flints, mixed with an alkali as a flux; but this kind of glass is now also made from the fine white sand of Lynn Regis, mixed with a certain proportion of the crystal glass itself, and the flux employed is potash, obtained by purifying the common pearlash with hot water. Plate glass is made from 100 parts of the finest white sand, mixed with 100 parts of pounded glass, 34 parts of dried, purified soda, and 14 parts of carbonate of lime. This very superior kind of glass is not made by blowing, as all other kinds of glass, but by casting the fluid mixture on a flat slab. At the celebrated works of St. Gobain in France, these slabs are of thick, smooth copper, supported by a strong foundation of masonry. Sand is extensively used in the grinding and polishing of plate glass. The grinding is performed before the polishing, in order to free the surface of the glass from all kinds of inequality and roughness. Two plates of the glass to be ground are strongly cemented to thin blocks of stone, or to frames of wood, and one plate being laid upon the other, wet sand is interposed between the two, and they are made to rub thus in contact with each other, till a smooth, even surface is produced. Fine sand is afterwards used, and is succeeded by emery, the actual polish being given by colcothar, which is a red and almost pure oxyde of iron, obtained from the retorts used in making aqua fortis.

The sand arising from the decomposition of basalt, is capable of forming a green-coloured glass of inferior transparency, without the addition of any foreign substance as a flux. Bottles were at one time made in the province of Languedoc by the fusion of this decomposed basalt, some of the ingredients of which serve as a flux without the addition of any alkali.

The process of making the commonest glass is so simple as to have been successfully performed without any of the apparatus of the glass-house, by simply throwing sea water several times successively upon a heap of sand, in which the salt would be deposited by the evaporation of the water, and the heap thus treated has been melted into glass. This has been done on some part of the coast of Scotland, but we are not certain of the locality. It is no unusual occupation, also, in the forests of Germany, for small gangs of men to wander about, following the avocation of itinerant glass-makers. They fix upon a place for their temporary works where they can procure fine sand, in a neighbourhood where wood is abundant. They burn the wood into ashes, which they mix with the sand for an alkali, and they blow, and afterwards spread out the fused mass into a common kind of window glass, which was at one time extensively imported into this country. The sand for the works at St. Gobain is procured from Creil, Nevers, and Etampes, and consists wholly of crystallized grains of quartz. M. Romé de l'Isle minutely describes the sand which was met with in the foundations of the Pont de Neuilly, as an assemblage of perfect transparent crystals, of which the form was that of an intermediate hexahedral prism, terminated by two hexahedral pyramids. He adds, that the crystalline form is very distinct when the grains are examined through a microscope; that all the arrises are sharp; and that this, joined to the perfectly homogeneous structure of this bed of sand, leaves no room to doubt that it was precipitated from a fluid which held the silex in solution at the place where it is now met with. "The transparency and regularity of this crystal of microscopic rock," (says M. de l'Isle) "are the admiration of all who see it my cabinet."

EMPLOYMENT OF SAND FOR ARCHITECTURAL AND ENGINEERING PURPOSES.

The best kind of sand for mixing with lime to make mortar, is that which is sharpest, of a moderate fineness, and the most free from earthy and vegetable matter. Sharp river sand is esteemed excellent, and some varieties of pit sand, when clean and not too fine, may be employed. A sand much in request among builders is that produced by the wearing down of flints and other quartzose stones on the common roads: this material, which is called road-drift, is a remarkably sharp, gritty sand, forming excellent mortar. By rubbing a small quantity of sand in the palm of the hand, we may readily ascertain if it be of that sharp quality necessary to make good mortar; and its purity and freedom from extraneous mixture may be tested by putting a little into water, which, if rendered turbid by the sand, will indicate that the latter is dirty, and requires washing. Sea sand is objectionable, because the saline particles which it contains are said to prevent the mortar from setting hard. This is principally due to the affinity which salt possesses for moisture, the water it imbibes from the atmosphere being prevented from evaporating, without which the mortar cannot become hard. Sea sand, however, by being thoroughly washed, may be freed from saline ingredients, and there are examples of its use in concrete, where, as in the sea-wall at Brighton, a work of considerable magnitude, the sand of the beach was employed without any previous washing.

The proportion of sand which should be added to the lime in mixing mortar, depends entirely upon the quality of the stone from

which the lime has been burnt. Some of the weakest limes, as those from the soft white chalk, will take the greatest quantity of sand without injuring their quality, because they consist of almost pure carbonate of lime. And, on the other hand, some of the strongest limes, particularly those possessing hydraulic properties, at the lias and grey chalk, will admit of only a small proportion of sand, because they all contain a greater or less proportion of argilla or clay, which of course diminishes their purity as calcareous stones. This remark applies yet more strongly to Roman cement, which, containing more clay than any kind of lime mortar, will only admit of a very small proportion, seldom more than one half its bulk, of sand. In the mortar commonly made about London, from the lime of the soft white chalk, it is usual to employ two and a half or even three parts of sand to one of lime. In other kinds of mortar, various proportions are used, up to equal quantities of lime and sand, or even sometimes a greater quantity of the former is used, according to the quality of the lime, as already explained.

The celebrated Dutch terras is the sand produced by breaking up a kind of wacké or cellular basalt, which, after being sifted, is mixed with lime, and forms the hydraulic mortar, which has been so long distinguished throughout Europe for its most valuable qualities of setting under water. The Dutch employ the terras with an argillaceous mortar, and consequently the proportion of terras which they use is not more than one part of it mixed with two of slacked lime. In using terras with a rich or fat, that is with a pure lime, equal quantities of the terras and the lime may be employed, and even a greater proportion of the former might be used with the pure chalk limes of this country.

It has long since been suggested by Mr. Aikin, in his Dictionary of Chemistry, and is even said to have been established by experiment, that the common compact basalt will answer equally well for making terras with the cellular, lava-like basalt of Holland. This should not be neglected by architects and others, who are executing works in the neighbourhood of basaltic districts. It is necessary that the lumps of stone should first be broken up into pieces the size of an egg, and then calcined, which may be done in a common lime kiln. The calcination will cause them to break readily with the hammer into small pieces, not much larger than grains of wheat, and the sand thus formed should then be sifted through fine sieves, the powder which passes through being rejected, while the remainder will be a coarse grit sand, probably not inferior in quality to the best terras.

The powder of puzzolana, although not properly a sand, may be noticed while speaking of mortars. When mixed with lime, either with or without common sand, it forms a mortar which sets remarkably hard, even under water. The preparation which puzzolana undergoes is similar to that of terras, namely, grinding and sifting, by means of which the coarsest part of the powder only is left. Puzzolana appears to consist of a calcined ferruginous clay, thrown out from volcanoes in the form of ashes.

Sand is very generally employed in combination with asphaltic and bituminous cements, to which it imparts the hardness and solidity of natural stone. Various proportions of sand are used, from about one-third of the whole mass by weight, up to three parts of sand to one of the cement. The natural bituminous molasse will not admit so large a proportion of sand as this, because it contains other matters in combination with it, which impair its purity as a bitumen. The artificial bituminous and resinous cements, on the contrary, will take a considerable proportion of sand, because they consist wholly of the bituminous matter, mixed with carbonate of lime or chalk. In the specification of Robert Harcourt, who patented the first artificial bituminous cement in this country, the addition of oil, tar, or tallow in small proportions, is recommended, in order to give fluidity to the cement, and to render it capable of combining with a greater quantity of sand. It should be remarked, however, that tar injures the adhesive properties of all bituminous and resinous substances, and oil and tallow do so in a much greater degree. They should therefore be avoided, where it is intended to form an artificial bituminous stone, or whenever the cement is required to adhere to walls, to fix iron railings, or to unite stone, brick-work, or timber.

Several of the asphaltic companies, when the material was first introduced to this country, employed a kind of sand from the bed of the Seine, to mix with it in forming the footpaths where the cement was first tried. The use of such an expensive sand as this must have been, considering the distance from which it was brought, probably originated in the fact, that this particular sand had been used in all the works in and about Paris, where the asphalte had previously been extensively used. It seemed that the patentees who brought it into this country, apprehending the consequences of any departure from the exact precedent according to which their operations were planned, made use of the sand of the Seine in preference to many other kinds abounding every where around London, which would have answered much better. The sand of the Seine, which was used for mixing with asphalte, is not a quartzose sand, but consists entirely of small, worn, comminuted pieces of chalk of an oblong flattened shape, and rubbed quite smooth by friction with each other. Any of these minute pieces can easily be broken in the hand, and a number of them can readily be reduced to powder in a mortar. All this is far from being the case with the grains of siliceous sand, which, being moreover sharp and angular, is better calculated to adhere, and to be cemented more firmly in the stone, than the smooth, rounded grains of chalk.

It is probable that a practice, which could only excite ridicule amongst those who witnessed it in this country, has been long since abandoned by the asphaltic companies.

The bituminous molasse of Seyssell, and other places in the Jura mountains, is composed of lime in combination with bitumen; but there are several places in this country where a bituminous sandstone is met with. Among these may be mentioned Chilley in the county of Sussex, where the stone is supposed to have been worked by the Romans.

GUANO MANURE.

It has long been known that amongst excrementitious solid substances, one of the most powerful manures is the dung of birds that feed on animal food, particularly the dung of sea birds.

The Guano manure is a production of this kind, being the excrementitious deposits of myriads of sea-birds of past ages, frequenting several islands in the Pacific Ocean, adjoining the coasts of Bolivia and Peru, where its valuable properties have long caused it be used by the agriculturists, for fertilizing their sterile plains. Guano having now become an article of commerce, is imported into this country by Messrs. Rounthwaite and Co. of Liverpool, from whose statement the following account of it is taken:—

It is found to be a most valuable and durable, and not an impoverishing manure, the use of which produces the most luxuriant vegetation, and the richest crops. The composition of Guano points out how admirably it is fitted for a manure, for not only does it contain ammoniacal salts in abundance, but also those inorganic constituents which are indispensable for the development of plants. It has been used on different farms and on every different crop, and not only in no instance has failure attended its application, but in every case its produce has astonished the farmer who has used it.

An extract from Professor Leibig's work says:—"The increase of crops obtained by the use of Guano is very remarkable; the crop of potatoes is increased 45 times by means of it, and that of maize 35 times.

It has been found by analysis that Guano contains a fourth part of its weight of uric acid, partly saturated with ammonia, and partly with potash, some phosphoric acid combined with the basis, and likewise with lime, small quantities of sulphate and muriate of potash, a little fatty matter, and some quartzose sand.

For potatoes, wheat, barley, oats, hops and turnips, the results of its application have been astonishing and satisfactory. Its weight is about fifty pounds to the bushel, and four bushels or about two hundred pounds mixed with one bushel of powdered wood charcoal, is considered sufficient for a statute acre, and may be applied by drill with the seed; and also broad cast over the land, being afterwards ploughed or harrowed in; but from experiments lately made, it appears that the best mode of applying Guano for one acre of wheat, barley or oats is, to mix two hundredweight with four or five bushels of bone dust; but some practical farmers recommend that about one bushel of charcoal should be added, from which the same advantages will always be derived; the charcoal having the power of holding ammonia in its pores; and it has been found that the mixing and applying it with Guano has rendered the second year's crop almost as abundant as the first.

For green crops in general, charcoal alone will be necessary to mix with it, but should a farmer prefer other means of applying it to his land, he can scarcely go wrong in making trial of his plan: the great assistance that can be given to manures of this description is, to diffuse them among the roots of the plants, and consequently as much as possible amongst the lands they are applied to; but use it in almost any way, its component parts are so essentially manures, that they must be absorbed by the growing plants.

The following results from the application of Guano, were furnished to Messrs. Rounthwaite by experienced farmers and experimentalists.

Barley and Clover.—In 1840, Guano was applied to some barley, and the yield was most luxuriant; the following year the clover on the same ground gave half a ton more than any other part of the field, where Guano was not used.

Turnips.—A farmer mixed about 14 bushels of ashes with ½ cwt. Guano, and applied it for turnips, by sprinkling it broadcast on the land, and harrowing it in. The seed soon vegetated, and the plants soon surpassed those manured with dung and mould only. It was used at the rate of 2 cwt. Guano to the acre.

Barley.—A small quantity of Guano was sown last spring with some barley without ashes or charcoal, in very dry weather. The barley came up some days earlier; it was much more luxuriant the whole season, and produced half as much more corn, and double the quantity of straw than where Guano was not used.

Wheat.—A farmer of high reputation applied 200 lbs. weight of Guano to an acre, and on the same field, on an equal space of land, 15 bushels of bone dust. Both were drilled into the ground, with seed wheat. The bone dust gave 4½ quarters of wheat—the Guano 6 quarters, 2 bushels, and 1½ pecks.

Grasses, &c.—Guano has been applied with very great success, and equally marked advantage, to grasses; also to potatoes and other vegetables.

The present price of the Guano manure at Liverpool is 16*s.* per cwt., or in quantities exceeding 5 tons, 15*s.* per cwt.

We shall be happy to hear from any land agents or others of our friends who are connected with the landed interest, the results of any application of the Guano manure with which they are acquainted, together with information as to the way in which it is applied, whether mixed with charcoal, bone dust, or other substances.

COLONIAL SURVEYS.

THE survey of lands belonging to the crown, and to private companies, in the colonies of Australia and New Zealand, will furnish a considerable amount of employment for surveyors. The New Zealand company has already sent out not less than four surveying expeditions, without including those sent out by the Plymouth company of New Zealand, which is now incorporated with the other. The two last expeditions of the company consisted of one chief surveyor or engineer, two first assistant surveyors, four second assistants, and ten apprentices, or cadets, who were to be instructed in their profession by the surveyors, and who would consequently soon be competent to undertake surveying themselves.

Within the last twelve months, the government has sent out several bodies of surveyors to New Zealand, Australia, and Ceylon, and the bill now before Parliament for regulating the survey and sales of land belonging to the crown, in the Australian colonies and New Zealand, will considerably extend the scale of their surveying operations in those countries.

This Bill provides that none of the crown lands, except those required for public uses, shall be conveyed or alienated except by way of sale; and that such sales shall take place quarterly within the colony, by proclamation of the governor. The lowest upset price for any lands of the crown in either of the above named colonies, is at present fixed at twenty shillings per acre, below which none can be sold; but this upset price is liable to be raised in future by authority of the governor.

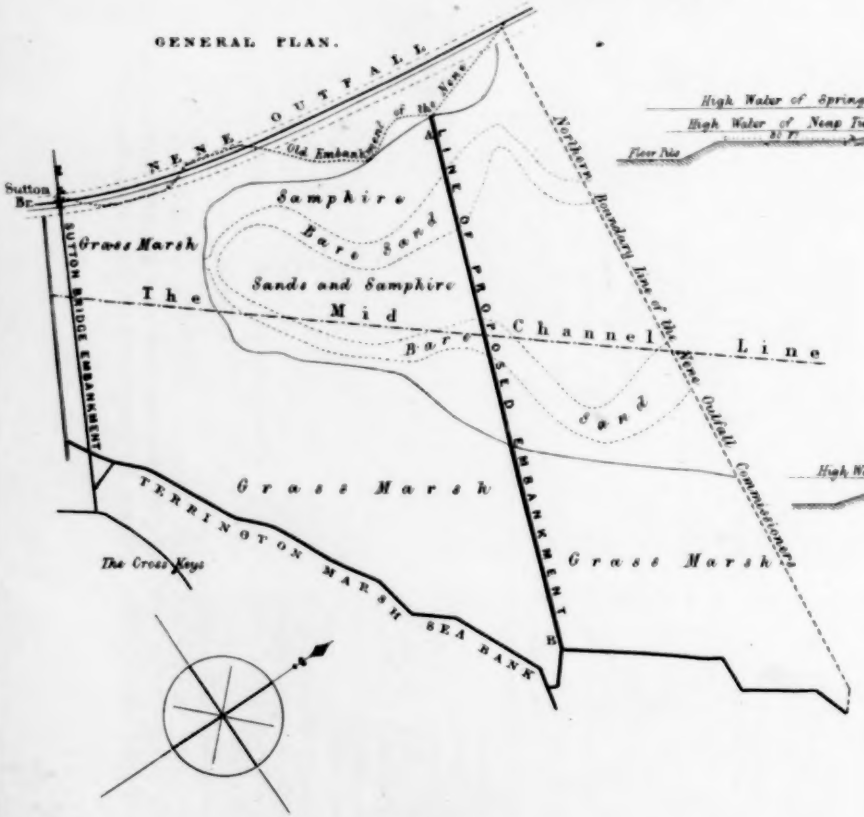
Her Majesty, however, is empowered to set apart, or to sell or dispose of in any other way, lands required for public uses, comprising those which may be necessary for public roads or other internal communication, those required for the benefit of the Aborigines, for purposes of military defence, for places of public worship, interment of the dead, for recreation or amusement of the inhabitants of any town or village, or as the sites of public quays or landing places, on the sea coast or navigable rivers, or for any other purpose of public safety, convenience, health, or enjoyment.

The Bill then enacts that no lands, with one exception which we shall allude to presently, shall be sold until they shall have been surveyed and delineated in the public charts of the colony: and the lots in which they shall be offered for sale shall not exceed one square mile, or 640 acres. The lots are distinguished into three classes, namely, town lots, suburban lots, and country lots. The first of these comprizes all lands situate within the limits of any existing town, or within any locality to be named by the governor as the site of any future town. The suburban lots comprize all lands situate within five miles from the nearest part of any existing or contemplated town. And the third class comprises all lands not included under the two former descriptions.

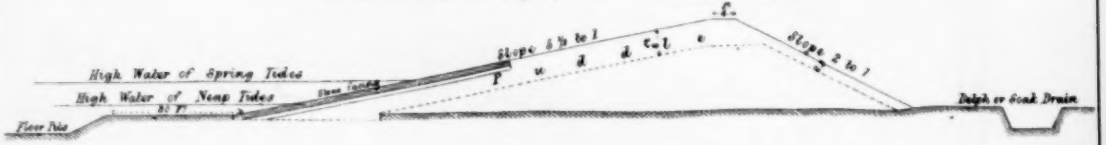
The exception above alluded to, as to the sale of lands in one particular case, in greater lots than one square mile is the following:—"That if any person or persons shall offer to purchase from the governor of any such colony by private contract, any block of unsurveyed land comprising 20,000 acres or more, and forming, as nearly as the natural land-marks of the country will admit, a parallelogram, of which no one side shall be more than twice the length of any other side, it shall be lawful for the governor, by any such private contract, to effect any such sale on such terms and conditions as to him shall seem meet." Such lands are not to be sold for less than the lowest upset price of other lands in the same colony. The purchasers not to be entitled to a survey of such large blocks of lands, except so far as may be necessary to ascertain the external marks and boundaries thereof.

It is provided that the expenses of surveying and managing the

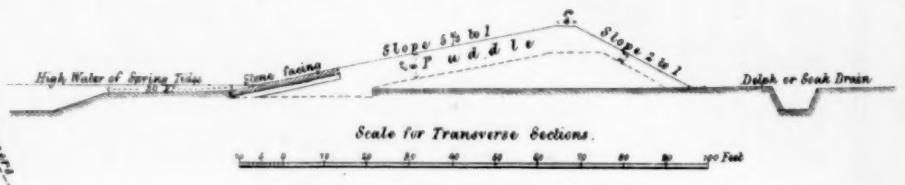
PROPOSED EMBANKMENT ACROSS THE OLD ESTUARY OF THE NENE.



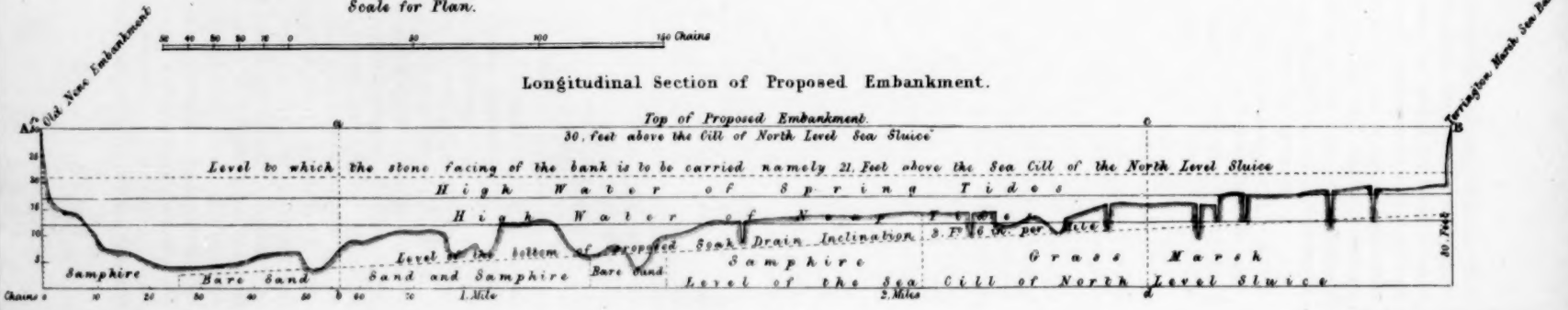
Transverse Section of proposed Embankment at *a.b*



Transverse Section of proposed Embankment at *c.d*


Slope 5½ to 1
Slope 2 to 1
High Water of Spring Tides
Stone facing
Top
Width
Delph or Soak Drain
Scale for Transverse Sections.
10 5 0 10 20 30 40 50 60 70 80 90 100 Feet

Longitudinal Section of Proposed Embankment.


Old Nene Embankment
Terrington Marsh Sea Bank
Top of Proposed Embankment
30 feet above the Cill of North Level Sea Sluice
Level to which the stone facing of the bank is to be carried namely 21 Feet above the Sea Cill of the North Level Sluice
High Water of Spring Tides
High Water of Neap Tides
Level of the bottom of proposed Soak Drain Inclination 3 Feet 6 Inches per Mile
Samphire
Bare Sand
Sand and Samphire
Bare Sand
Samphire
Grass Marsh
Level of the Sea Cill of North Level Sluice
Chains 0 10 20 30 40 50 60 70
1 Mile
2 Miles
30 Feet

J.R. Jobbins, lithe

J. Weale, Architectural Library 59, High Holborn.

crown lands, and of effecting the sales, shall in the first instance be chargeable upon and defrayed from the proceeds or sales of such lands, unless provision shall otherwise be made for defraying such charges by any law or ordinance to be enacted by the local legislatures of the colonies.

One half part at least of the proceeds from the sale of the lands is to be appropriated towards defraying the expenses of sending emigrants from this country to the colonies. The Bill further provides, that payment for lands in the colonies may be made in this country, and for the granting of certificates of such payments by the Commissioners of colonial lands and emigration.

PROPOSED EMBANKMENT ACROSS THE OLD ESTUARY OF THE NENE.

(*With a Plate.*)

THIS magnificent project for embanking against the sea nearly 4,000 acres of land, by means of a massive earthen embankment about 3½ miles in length, has been designed for the Nene Outfall Commissioners, under the able direction of Sir John Rennie, civil engineer. The work is on the eve of commencement, the Commissioners having entered into a contract for its execution within the last few days. We esteem ourselves highly fortunate in being able at so early a period to place before our readers the details of an undertaking unrivalled in magnitude and importance by any similar work of the present day. The river Nene, where its waters formerly fell into the Wash, forms the boundary between the counties of Norfolk and Cambridge. Its estuary has been nearly dry, however, since the formation of a new cut, well known by the name of the Nene Outfall. This was the work of the late Mr. Rennie, who carried into effect those immense projects of drainage, which, by lowering the beds of the rivers Ouse and Nene about 10 feet, brought no less than 300,000 acres of land into cultivation.

The following is the specification according to which the embankment and the works connected with it are to be executed, and the plate contains the plan and sections referred to in the specification :—

SPECIFICATION OF THE MODE OF CONSTRUCTING A BANK OVER THE OLD ESTUARY OF THE NENE, UPON THE LINE MARKED A.B. UPON THE ACCOMPANYING PLAN AND SECTION.

THE bank is to be executed according to the forms, dimensions, and direction, as more particularly described in the accompanying plan and section, and this specification.

The seat of the bank is to be prepared in the first instance by removing all sods and soft soil unfit for the purpose ; the sods are to be carefully laid by, and used on the slopes of the bank.

The sea, or outer slope, from the top of the bank to the toe of the slope, is to be five feet four inches horizontal, to one foot perpendicular ; the inner, or land side slope, is to be two feet horizontal to one foot perpendicular.

The top of the bank is to be four feet wide, and to be made and maintained throughout of the height of thirty feet above the sea cill of the North Level sluice.

The earth of which the bank is to be composed, is to be taken from the sands and marshes on the sea side of the line of embankment, the best of which is to be selected for the purpose, and none of it is to be taken within ten yards from the foot or toe of the outer slope, and the floor pits from whence the earth is to be taken are to be cut with a slope of not less than four to one next to the bank.

The earth is to be placed upon the bank by carts and horses, except where it may be necessary to finish it on the top and sides. It is to be spread equally, in order that the whole mass may be equally solid and consistent throughout.

The best of the earth is to be selected for the outside of the bank ; and the outer slope and top for a depth of six feet, and the back for a depth of two feet three inches, taken at right angles to the slope, are to be faced with the very best material that can be procured from the open marsh on the sea side of the line of embankment, and well beat and puddled together.

The surface of the outer slope, for a depth of twelve inches inwards, is to be well worked up with chopped straw or coarse grass where it is proposed to use stone.

The sea slope of the bank is to be faced with clunch, cliff, or other stone, not less than nine inches thick, extending from the bottom of the slope throughout, to a vertical height of twenty-one feet above the level of the sea cill of the North Level sluice.

The stone is to be well rammed into the face of the slope with wooden beaters, and imbedded in coarse grass or straw. The surface of the outer and inner slopes and top of the bank, above the stone, is to be dressed to a general inclination, as shown in the drawings, solidly beaten with wooden beaters, and covered with grass sods not less than three inches deep, procured from the open marsh on the sea side of the line of embankment.

At the back of the bank, at six yards distance from the toe of it, there is to be a delph or soak drain four feet wide at bottom, six feet deep at the upper end, and falling at the rate of three feet six inches per mile, and increasing also two feet per mile in width at the bottom, until it reaches the lower end, with sufficient batters and slopes to prevent the sides from falling in.

All creeks intercepted by the line of embankment are to be diverted into the delph or soak drain above described.

In crossing any creeks where there is a run of water, the creeks must be filled up to the level of the adjoining marsh with the best of the earth, well worked with grass, straw, sedge, or wilt, to the width of the sea side forelands, (that is to say) thirty feet from the base of the bank. If there should be any scour, the foot of the bank is to be protected with fascines or kidwork.

The contractor is not to stop up or damage the drainage of any lands now draining through the marsh proposed to be enclosed.

The warp now deposited on the sands and marshes proposed to be embanked is not to be disturbed, and the marsh is not to be allowed to scour away, nor new creeks to be formed, nor the present creeks to shift their course ; but the contractor is to preserve the works of the Commissioners in these respects ; and all that part of the estuary intended to be included within the bank, which is composed of sand, and not now fit for cultivation, is to be warped up by means of jetties, fascine, or kidwork, or other proper means, in order that the same may be fit for cultivation, previous to making the embankment.

The whole of the workmanship and materials are to be the very best of their respective kinds, and the work is to be commenced, and proceeded in, and completed, to the entire satisfaction of the principal engineer of the Nene Outfall Commissioners ; and if, after the works shall have been completed, any imperfection, or indifferent workmanship or materials, shall appear, the contractor is

to make good the same at his own cost and charge, so that the whole of the work shall be delivered completely finished and perfect in all its parts, in the opinion of the principal engineer to the Nene Outfall Commissioners.

The contractor is to find all his own tools, materials, carts, horses, waggons, planks, barrows, pumps, engines, and everything else of whatever sort or kind, that may be necessary to carry on and complete the work. He is to take his own dimensions and levels on the site of the proposed embankment, and be responsible for them, in order that the works may be completed according to the true meaning and intent of the contract; and he is also to take the risk, and be responsible for all accidents or damage of any sort or kind, or arising from any cause whatever, during the execution of the works contracted for, either to the works themselves, or to any banks or works under the charge of the said Commissioners; and he is to indemnify the Commissioners against all claims by any person or bodies whomsoever for damages occasioned by reason of the execution of the works, and he is to repair all such damage (if any) at his own expense. He is to send in his tender at a gross sum, and be responsible for the completion of the work, and to uphold it for one year after completion without any extra charge, and the whole of the works, including warping, are to be finished by the 11th of October, 1843.

The work is to be measured up every fortnight, and a certificate is to be made out and signed by the principal engineer, upon which the contractor shall be authorized to draw nine-tenths of the amount: the remaining one-tenth is to be reserved by the Commissioners until the completion of the work, the Commissioners paying £4 per cent. interest on the money so reserved when the same shall have amounted to £1000.

If, during the progress of the work, any alteration in, or addition to, or deduction from the dimensions or quality of work described in the plan and specification, shall, in the opinion of the principal engineer, appear to be necessary or expedient, he is to be at liberty to make such alteration, addition, or deduction, awarding to the contractor what he shall think reasonable for any addition, and deducting where less is required; but no such alteration, addition, or deduction, shall invalidate or affect the contract, otherwise than as to the amount thereof.

The contractor is to bind himself in £6000, with two sureties in £3000 each, which will be forfeited in the event of non-performance of the contract, together with any additional sum that may be necessary to complete the work.

In the event of the contractor not employing sufficient men or materials necessary in the judgment of the principal engineer to carry on and complete the work within the time specified, the principal engineer shall have full power to take the work out of his hands, and to employ such additional men and materials as he may think proper, and to charge the contractor therewith, and to make use of any tools and materials which may then be on the ground for the execution of the work.

If any dispute or difference of any kind shall arise during the execution or progress of the works, either as regards the drawings, specification, contract, or materials; or if, after having completed the works, any dispute shall arise regarding the measurements, the accounts, the contract, or anything belonging thereto or connected therewith, the same shall be decided by the principal engineer of the Nene Outfall Commissioners, whose decision shall be final, and binding upon all parties.

The Commissioners of the Nene Outfall do not bind themselves to accept the lowest tender, or any tender, unless they think it expedient.

JOHN RENNIE.

London, 16th April, 1842.

The following quantities are the result which we have been furnished with from an accurate measurement of the section and plan:—

	Cube yds.
Earthwork.—Total quantity of earth in embankment	884,165
The part of this quantity which is to be puddled, as described in the preceding specification	423,142
Stuff to be cut out of soak drain	40,614
Stuff to be cut out at the toe of embankment	22,274
Stonework.—Stone facing of embankment	28,497
Warping.—Area of land to be warped	acres 1,272

TESTING THE STRENGTH OF IRON BEAMS.

REPORT OF EXPERIMENTS MADE AT MESSRS. COTTAM AND HALLEN'S FOUNDRY TO TEST THE IRON GIRDERS OF NEW CROSS BRIDGE.

THE girders, which were cast by Messrs. Cottam and Hallen, according to the specification and drawings furnished to them, are segments of a circle, 30 feet in length measured on the chord line, 15 inches deep in the centre, and 14 inches at the ends. They are of the form and section denominated grooved beams, the centre part being 2 inches in thickness, and the top and bottom flanges 8 inches wide and 2 inches deep.

The weight which the girders ought to bear in the centre, without injury to their elastic force, was accurately calculated by Tredgold's formula, and found to be 15 tons 4 cwt. The exterior girders, however, are cast with flanges only 5 inches wide, and projecting only on one side, and the weight they are calculated to bear, found by the same formula, is 10 tons 5 cwt.

In order that the testing force may be applied in the most convenient manner, the girders, ten in number, were placed in pairs, one pair above another, so that the two girders of each pair were in contact with each other only at the ends.

In this position, therefore, the effect of the force applied is to press the opposite girders closer together, and half the amount of the diminished distance between the girders, in consequence of this force, will evidently be the measure of the deflexion of each girder, with a weight equivalent to the force employed.

The hydraulic press was fixed upon as affording the most convenient means of testing the girders, to the extent required. The following are the dimensions of the press used:

Piston of pump	·7 inches diameter.
The pressing ram	3·88 „ „
The length of the lever or pump handle from the fulcrum to the point of applying the weight	4 feet.
The length from the fulcrum to the junction with the piston rod	4 inches.

Now, in this pump, the ratio of any applied power to the effect produced without the assistance of the lever, is of course equivalent to the ratio of the squares of the diameters of the piston and the

ram or the power is to the effect as 1 to 30·72. The power applied to the lever produces an effect twelve times as great; therefore the power of the pump is to the whole effect as 1 to 30·72 × 12, or as 1 to 368·64. The weight of the lever itself is 3½ lb., and its effect therefore is 3½ × 368·64 = 10 cwt. or half a ton. The force which it was determined to apply to test the beams having been fixed at 10 tons, the weight to be suspended from the lever in order to produce this pressure on the girders is found thus:—

Tons.	Effect of Handle.	Tons.	lb.
10	– ¼	= 9½ = 21280. Then $\frac{21280}{368{\cdot}64}$ = 57 lb.—	

the weight which should be applied to the lever to produce the effect of a weight of 10 tons on the girders.

By the same mode of calculation, the weight which should be used to test the end girders with a force of 8½ tons, is found to be 49 lb.

The following table exhibits the result of the application of the force to each of the five pair of beams; in which, however, it must be remarked, that the amounts of deflexion are divided between the two opposite beams, inasmuch as they indicate the diminished distance between the beams during the application of the force.

Number of each pair.	Force applied. Tons.	Weight attached to the lever. lb.	Deflexion. Inches.
1st	10	56	1·
2nd	10	56	0·8125
3rd	10	56	0·75
4th	8½	49	0·875
5th	10	56	0·875

The only other remark it is necessary to make on these experiments is, that in every case, immediately on the removal of the pressure, the girders sprung back the full amount to which they had been pressed together, thus rendering it clear that no permanent set whatever had been occasioned, and that their elastic force had been in no way injured.

THE BETHNAL GREEN CHURCHES:

THEIR MEANNESS, AND EVIL AS WELL AS GOOD EFFECT.

We lately went to the wretched district of these new Christian sanctuaries, and came home with feelings by no means flattering to the pride of our stout-hearted church principles. After reflecting moodily for a month or so, we determined to make another pilgrimage to this metropolitan desert. There is something peculiarly depressing to the spirits in the appearance of this portion of the capital,—a maze of long, narrow streets, lanes, and bye-ways, flanked by an interminable collection of mean, dingy, weavers' houses,—a puddle at every door,—and long ranges of crazy garret-windows, stretched the whole length of every house; all the streets are alike dirty and ill-paved, and few of them have any footways: squalor is alike visible in the aspect of the streets, the dwellings, and their inhabitants.

The second time we took a view of these churches was on the Sabbath. There was a crowd of boys shouting and running about in front of one of them; they had a couple of sparrows tied together by a short string, and whenever the birds, on being turned adrift, attempted to fly, they quickly fell to the ground among their tormentors, who were hunting and pelting them with stones and brick-bats. This scene was followed up by a young man, who was worrying a hen by throwing a heavy stick at it, which occasioned the fowl to attempt to escape, partly on foot and partly on its little-used wings. We had no sooner left this exhibition, and crossed a lane or two, than we were encountered and nearly thrown down by a huge hog, which, threading this intricate and interminable forest of nastiness, was running from another set of scape-graces, who were imitating, as nearly as possible, the pleasures of a wild-boar hunt. The games of peg-top and chuck-farthing were being carried on in every street. Above many a house-top was to be seen a dirty squalid figure, with face coarsely brambled all over from ear to ear and from neck to mouth, with a week or two's unshaven and unwashed beard, thrust out from some wretched garret, overrun with vermin, with wand in hand, encouraging with busy laziness the circuitous flight of a flock of pigeons, in which amusement the dirty slomacking amateur expended as much time and money as might have rendered himself and all his family cleanly and comfortable, and left him unsmirched by the trap-filching of his neighbours' birds.

We found, alas! the new churches arising in this district calculated to fix upon the neighbourhood its meanness and miserable aspect. We had indeed hoped that, by wisdom in the outlay of the public subscriptions, a far different result would have been obtained; that the style of the secular edifices of the neighbourhood would have been prompted to improvement, by the superiority of the new ecclesiastical fabrics; but, bad as are most of the Bethnal Green houses, considered as domestic habitations,—still more paltry, shabby, and mean are these new churches, considered as temples of the living God.

There is so proper a feeling exhibited on this subject by the Rev. H. Melvill, B.D., who has been so strenuous in the cause of these very churches, and who by his preaching has prompted overflowing congregations to contribute so largely to their funds, that we think no apology required for quoting from a sermon preached by him, Oct. 27th, 1839, at Camden Chapel, Camberwell, the following able and elegant observations:—

"And thus you have an argument (so to speak) in our text against any country, when the sumptuousness of its secular buildings forms a contrast with the meanness of its religious. The argument hitherto has been, that a country is justly condemned, when the number of its churches bears no just proportion to the number of its houses; but now it is the character or style of the respective buildings, which is appealed to in evidence, and the comparison lies between mean temples and magnificent dwellings. It cannot tell well for a land, if its opulence is more shown in other structures, than in those which are devoted to the service of God. I know that the Almighty "dwelleth not in temples made with hands," and that it is not the gorgeousness of architecture, which will attract His presence or fix His residence; I am well assured, that He will come down as benignantly and abide as graciously, when His servants have assembled in the rude village church, as when they gather in long-drawn aisles and under fretted roofs. But this has nothing to do with the question as to the propriety of our throwing splendour round our religious edifices, whensoever it is in our power to do so. The mean building may have the Shechinah within it, as well as the magnificent; but is this any reason why we should rear only the mean, if we have it in our power to rear the magnificent? I think not. God was content to have a tabernacle, while His people were in the wilderness, destitute of wealth and still harassed by enemies; but when He had given them abundance and peace, He required a temple, of which David, when meditating the structure, could say, "The house that is to be builded to the Lord must be exceeding magnificent." And when that house arose, it was the wonder of the earth; the gold and the silver and the precious stones were lavished on its walls, and the temple soared into the skies, a glorious mass, effulgent as though it had descended from above, or rather as if it had been raised by immortal hands. We forget not again the change of

dispensation, when we derive from the splendour of the Jewish sanctuary an argument for beautifying the house of the Lord; but we do think, that when with every token of approval the Almighty took possession of a structure, on which architecture had exhausted all its power, and wealth had poured all its treasure, He did give evidence that churches, inasmuch as they are structures reared to His honour, ought to exhibit the opulence of the builders of houses, and to be monuments of the readiness of piety to devote to the Lord the riches derived from His bounty.

And we cannot take it as any wholesome symptom, which is now to be observed in this country, that whilst other structures are advancing in magnificence, churches are of a less costly style. If we compare ourselves with our ancestors, it may be said that we build more spacious and luxurious houses. If we want new Exchanges, they shall be such as quite to throw the old into the shade. New houses of Parliament—they shall wondrously outdo what the fire has destroyed. Yea, even new hospitals and infirmaries—they shall be almost as palaces, compared with those of olden days. But if we want new churches, they shall be as simple and unadorned as possible; contrasting strangely with the gorgeous and arched and richly sculptured piles, which a former age delighted to consecrate to God. Better, indeed, struggling as we are to overtake a redundant population, to have the two plain churches than the one stately edifice. But there is wealth enough in the land, wealth displayed by the "ceiled houses" of every other kind, to admit of churches being costly as well as numerous; and the question is, whether it will not at last tell against us as a people, that whilst we were enabled to go beyond our ancestors in the magnificence of all other buildings, whether public or private, we have adopted a more niggardly style in regard of our churches, as though it were unimportant either to God or ourselves what kind of structure was set apart for the offices of religion. It is *not* unimportant. Not unimportant in respect of God; for, if the church is His house, it ought, like the palace of a king, to bear as great proportion as we have power to effect to the majesty of the occupant. Not unimportant in respect of ourselves: who has not been conscious of the power of a cathedral, a power to excite lofty emotions and soaring thoughts, a power as though arch and pillar were indeed haunted by Deity, so solemnising and spiritualising are they as they surround and canopy the worshipper, like the stately avenues and the clustering boughs of a forest, from whose depths come out the utterances of a God? It is vain to endeavour to make ourselves independent of association; we must be content to be material as well as spiritual, and not disdain the aids which a place of worship may give to the piety of the worshippers. But at least it cannot tell well for the religious feeling of a country, if there be parsimony in the churches while there is profusion every where else. The churches—not the streets, not the squares, not the warehouses, not the docks, not the palaces, THE CHURCHES—ought to be the chief evidence, as well by their stateliness as their number, of the growing power and wealth of a kingdom. We have nothing to say against the multiplication of spacious mansions, and lofty edifices, in which commerce may hold her court, literature gather her votaries, or legislators debate; but woe be unto a country, if whilst all this goes forward the house of the Lord be not enlarged, or enlarged only at the least possible expence, so that its court is waste and spoiled while the other structures increase.

This is precisely the state of things, so indignantly denounced in our text. It is this, that called forth the expostulation of the prophet. And is it not to be seen amongst ourselves? Notwithstanding the vast efforts of the few last years, the want of church accommodation, especially in the metropolitan and manufacturing districts, is very greatly increased through the advance of population, whilst the structures reared for places of worship, reared under a system of grinding economy, are certainly (to say the least) no monument that the national piety is eager to consecrate unto God the national wealth. If you will contrast us with our ancestors in the number or the style of the houses built for God, only compare what is called the City with the more modern parts of our overgrown metropolis. The City is really crowded with churches; their spires are as a forest. And most of these ecclesiastical structures are of rare beauty and costly material; so that in many a narrow lane or obscure court, you may find a solid and richly ornamented building, contrasting strangely with those by which it is surrounded, but the contrast only showing that our forefathers thought it both a duty and a privilege to devote the best to God, and to keep the inferior for themselves. But pursue your way to the more modern parts of the metropolis, and you have line upon line of stately mansions—a magician would seem to have been there, conjuring up a multitude of palaces; but where and what (for the most part) are the churches? Alas! they do not crowd upon you, as in the streets where the old citizens dwelt; you may wander comparatively long distances without meeting a church. And when one rises, amidst some gorgeous assemblage of halls of nobles, or halls of science, in place of excelling the City church in any thing of the proportion that the modern mansion excels the ancient, it is commonly below, in all that may mark veneration of the Deity, those deserted edifices where past generations worshipped and now rest. And we want therefore to know, whether, if a prophet were now to rise in the midst of us, he might not fairly address to us the very expostulation contained in our text. I see him walking our spacious streets. He cannot take a step without fresh evidence that we have wondrously advanced in all the comforts and luxuries of life. He looks for proofs, that along with this advance there has been a growing manifestation of the national piety—a manifestation in that the number and sumptuousness of our churches at least keeps up with the number and sumptuousness of our dwellings. He looks *in vain*. And then with a voice of indignation, a voice which must strike terror into all who remember that "unto whom much is given, of them much is required," he exclaims to the passers-by—"Is it then for you, O ye, *to live in your ceiled houses*, AND THIS HOUSE LIE WASTE?"

The first of these churches which we examined, was the one at Friar's Mount; it is indeed a structure of pauperism, yet is designed with great ability. Our regret does not result from want of talent in its deviser. What architect could succeed better with such means at his disposal? To employ one upon such a work, is to set him to "kick against the pricks," which St. Paul himself, whose faith was strong enough to remove mountains, found at the outset hard enough. The disgust and disappointment which it causes, are the result of its sordid, grudging cheapness, and its poverty-striken materials; its whole texture is, as it were, of the shabbiest description of charity-cloth. There is something peculiarly shocking to the mind, something peculiarly grating to the soul, in the beholding of the whole exterior of a temple of God faced with the very meanest description of bricks, while upon the most loathsome temple of inebriation in the neighbourhood, there has been a large expenditure for some kind of face-work. There is some relief, it is true, by the arches and labels being of red brick, as if, in default of procuring architectural materials, their blood-stains were obliged to be accepted; indeed, these intended decorations only cause the meanness of the general materials to appear the more striking. We were not particularly well pleased, upon entering the church, to perceive under the labels of the altar window the waggeries of a sheep's head and a goat's head, indicative of salvation and perdition at the final judgment,—but which will occasion to many a blameless clergyman who happens to be assisting at the altar under the goat's head, the premature condemnation of the censorious.

On going to the other churches, we found prevailing the same wearisome round of paltriness, abject misery, and mistaken economy; and we never remember to have returned from a sight-seeing excursion, with spirits more depressed. These churches have the more wretched effect, from being almost close to those of Spitalfields and Shoreditch, two of the most magnificent parish churches in Europe.

If these churches had been of proper quality, we doubt not for even a moment, that they would have wrought a secular, as well as moral and spiritual, improvement upon the neighbourhood.

While we were examining one of them, a *roué* sort of personage came up to us and exclaimed, "What, you are looking at one of the Weavers' Cathedrals! it is not quite a St. Peter's, (though I hear it is to be dedicated to him) nor a St. Paul's! Though I care nothing for the pope, my father was a Catholic, and would have been ashamed to go to chapel in such a hovel! This is one of the bishop's new kennels, in which he is to keep his new puppies! Go to St. George's Fields, and see how *we* build churches!"

These observations greatly shocked us, accustomed as we are to

hold in singular reverence the episcopal office and dignity, and feeling a humble pride in having been confirmed by a late diocesan; believing, also, that the chronology of no other country or church can afford so illustrious a catalogue of men of sanctity, learning, and amiability, who have sat upon the episcopal bench—an order of our countrymen, who, for soundness of principles, assiduity in their calling, and gravity of life and conversation, have had no competitors, except in our illustrious judges, an order of men, too, in which England has been singularly blessed; indeed we have often thought with pleasure upon the singular fact, that our benches, episcopal and judicial, have, during centuries, had so few seated upon them whom any virtuous moderate man of any party would have wished removed. Used as we have been, from youth upwards, to consider that the house of God should be the longest, the broadest, the loftiest, the best-built, and the most handsomely furnished in the parish, we cannot have our eye-sight blinded by the practical blasphemy which is the result of the modern sophistry, that that which is plainest, (*i. e.*, the meanest and cheapest,) is most suited to the offices of religion.

We cannot be brought to believe, that, while private houses are filled with rich carved furniture of solid mahogany, oak, ebony, or rose-wood, piety is shown by making the furniture of the temple of the coarsest barn-door-like workmanship; if the churchman kneels at home upon a cushion of velvet, embroidered with threads of gold, we see little devotion in spreading the altar of God with rush-matting; if we behold the private table garnished with a profusion of spoons, forks, and vessels of silver and gold, we ask, What, could not one candle-stick, one salver, be spared for the altar-table, that the patten and the chalice might not be of pewter or plated copper?

Those who wish well to the peace of our English Israel, will be for doing all soundly, so firmly rooting everything to the soil, that, come a thousand Oliver Cromwells, and Praise-god-barebones, and Jameses the Second, the Anglican church, founded upon apostolical purity, and therefore in times and seasons unpalatable to the vices and cupidity of mankind, shall spring up again and again like the trampled corn, thicker, and stronger, and more flourishing, and find still existing its old fanes, sound and ready for prayer and preaching after the assault of the fanatical, and the blemishing of their carved-work by the pagan-minded.

Now, as it was a principle of the Levitical law, that whatever was given was to be of the best, the generosity of the heart being thereby justly tried,—no sheep with the rot was accepted, no broken-legged bullock received as a sin-offering; so we think all these churches, if given at all, aught to have been of the best: *one* only of these churches might have been much better built than they are, in each two years, and have left the principal untouched for the future building and endowment of others, as many as desired; or half the money might have been laid out in short reversions, producing a compound-interest accumulation at 8 per cent., or to become double every nine years; while the other half of the money might have been employed in building good and creditable fabrics, in the most necessitous places.

On the other hand, if these are intended to be mere temporary sanctuaries, tabernacles pitched on places where an enemy might otherwise have occupied the space by a chapel for the putting forth of some heresy or unruly principle, we then say, Why spend one farthing in making them other than mere roofs and walls, to be hereafter rebuilt, or to be embellished with window-tracery, spires, porches, and the other decencies which the man of a right frame of mind expects to find about church fabrics? Ten thousand pounds saved out of the fire in this way, would purchase a reversionary estate, which would produce at the end of forty years an annual rent of £10,000, for such a purchase, and double that sum if deferred another nine years.

But we do not think there is cause for such fear of occupation by chapels: the "voluntary principle," or rather voluntary want of principle, does not work in these abjectly poor districts: even in the richer ones, the *state* provision of churches has already wounded to the death the trafficking in the sanctuary, the cause for which buildings were set up and let as chapels, instead of to handicraftsmen: higher rents are not now to be procured in that way than from the householder. Many of these wretched hovels, built by men of no principle, no religious bias, after having been let in succession to congregations of strangely opposite professions, have at length been shut up tenantless: a very large proportion of the most flourishing chapels are deeply involved in debt: who, then, but the rich conscientious sectarian zealot, (and there are but few such,) would think of so bad a speculation as the building of a sectarian chapel in a place where even a church must be supported chiefly by extraneous means?

We think there needed to be no such haste in the running up of these homely tabernacles, as to occasion them to be so mean in their materials, finish, and furniture. We do not for a moment doubt that funds enough might soon have been collected for rendering them more substantial, and for finishing them in a far better manner. We believe, judging from what his appeals have before raised, that the sacred oratory of a single sermon preached by Mr. Melvill, would have brought funds enough to produce such improvements upon any one of these pauper churches; and we know one gentleman, who, having subscribed towards the churches, proposed to contribute still more largely, but on viewing those in hand, he desisted from farther gift, saying, that he was afraid *ducks and drakes* were being made of the money.

We hope, with our strong yearnings towards architecture, and the Anglican church, that if there be any shreds of the subscription left, they will, with the other church-building funds in hand, be used, if not more piously, at least with more discretion. It is a poor compliment to protestantism, that nearly all our good churches were built by the catholics, and nearly all the bad ones by ourselves: over this lamentable circumstance, the modern Romanist has many a chuckle, and predicts the re-possession of the edifices built by his forefathers. We hold this forth as a warning: we would have our archbishops and bishops, our priests and deacons, our rectors, lay and spiritual; our patrons and curates; our senators and our governors, better them, and wipe off the reproach: the times are altered from when the mean-souled waverer was afraid to support his church: let the bold arise fearlessly, and he will find even every trimmer on his side: every want of repair which the Anglican church needed through time, having been effected already, or being now in course of performance, the sectarian and the irreligious has now no longer cause for vituperation, or the shadow of it; and his outery will fall powerless, and his opposition will cease, while the church, in its true English-hearted principles, will thrive more and more.

TABLE OF PROPORTIONS OF VARIOUS MARINE STEAM ENGINES.

	ROYAL TAR.	BRAGANZA.	LONDONDERRY.	FAWCETT.	DON JUAN.
Diameter of cylinder	60	61¾	48	43½	68¼
Length of stroke	5 ft... 7½ in.	5ft. 6in.	4 ft. 4 in.	4 ft. 0 in.	6 ft. 0 in.
Size of steam ports	21 × 5½	23½ × 5½	19⅝ × 3⅝	15 × 3½	33 × 8
Ditto of steam pipe (*inside*)	11		10	8½	
Diameter of piston rod	6	6	4⅞	4½	7
Depth of eye of cross head	17⅞	16½	13½	13½	19½
Thickness of web of ditto (1)	4⅝	5¼ and 4¼	3½	3	4½ × 3⅜
Size of journals of ditto	× 5½	× 5⅝	3⅜ ×	3⅜ × 3⅞	6½ × 6½
Length of ditto between centres of journals	6 10⅞	7 0	5 3½	4 11½	8 0½
Length of side rods	9 2½	9 7	9 2	7 11	
Diameter of ditto at neck and at middle	4⅝ – 5½		3⅜	3½ –	4¾ and 5¼
Size of lower journals of ditto				3½ ×	5 × 6½
Length of side lever between extreme centres		15 5	11 0	12 4	17 6
Size of main centre journal	8 × 14	8½ × 14	7 × 8½	6½ ×	10 × 16¾
Depth of side lever at centre	2 6	2 7½	2 3½	1 11	3 6¾
Smallest depth at ends	1 4½	1 2	12½	9¾	1 9⅝
Average thickness of side levers (2)	2⅝	2⅝	2 × ⅞	2¾	2½
Contents of condensers in cubic inches	59 × 50 × 43½			26¾ × 37¾ × 32	
Size of injection pipe (*inside*)	4	4	3½	3	
Thickness of metal in condensers	2½		1⅜	1	
Ditto ditto in sole-plates	2¾		2	1½ and 2	
Sizes of holding-down bolts (3)	3 and 1⅝	1¾	2	1½	
Number of ditto	4 and 8	12	12	16	
Total length of connecting rod (4)		11 0	11 11	11 10½	13 9½
Smallest and greatest diameter of ditto	6½ and 7⅝	6⅝ and —	4⅜ and –	4¾ and	6⅝ – 7⅞
Size of crank pin journal	7 × 9⅜	7 × 9½	5½ ×	4⅞ ×	8¾ × 10
Depth of crank eye for crank pin	8⅞	9½	8	9	12
Ditto ditto for shaft (5)	11	10⅜	12½	9½	12½
Size of journals of intermediate shaft	12½ × 15½	12½ × 15	8 × 10	8⅞ × 10½	14 × 14⅞
Ditto of outside journal of paddle shaft	8⅜ × 10		6 ×	6¾ × 6¾	9½ × 10½
Length of paddle shaft over all		16 0			18 5
Ditto of intermediate shaft over all		10 10	9 0	8 0	11 5¾
Diameter of air pump	36⅝	3 2	2 3½	2 0⅜	3 0⅜
Length of stroke of ditto		3 0	2 5	2 0	4 0 nearly.
Size of discharge valves	36 × 12		25 × 8½	19¾ × 6½	31 × 13½
Diameter of air pump piston rods	5	4	3½	2¾	4¼
Depth of eye of crosshead	10½	9¾	9	9½	15½
Thickness of web of ditto	7⅞ and 4½		2⅜	2½	3 and 2½
Size of journals of ditto		3½ ×	2¾ ×	1¾ × 2½	4½ × 4½
Length of ditto between centres of journal	5 8⅜	5 9½	4 9	4 3	6 10⅞
Length of air pump side rods (*between centres.*)	3 8½		3 5½	3 3	
Greatest and least diameters of air pump side rods	3½ and 2½		and 2⅜	and 1⅞	4½ and 3¾
Height of crank centre above sole-plate		15 8½		14 3¾	17 7½
Ditto of main centre above do. do. (6)	2 2¾			1 6¾	3 9¾
Size of journals of valve weigh shaft			3½ ×		5 × 5⅞
Greatest diameter of ditto					5⅛
Length of ditto between centres of journals			3 11		4 10
Diameter of paddle wheel over the floats	23 0	24 0	18 8	17 8	24 6
Size of floats (7)	7 0 × 1 6	8 10 × 1 6	6 0 × 1 10	6 7 × 1 6½	9 10 × 3 0
Number of ditto	18	18	18	14	20
Number of sets of arms	3	3	2	3	3
Ditto of arms in each set	18	18	18	14	10
Size of arms (8)	4½ × 1	5 and 3⅝ × 1	5 and – × 1⅛	4 × 1	4½ and 3½ × 1¾
Number of rings for each set of arms	2	2	2	2	2
Size of outer rings	3 × ¾		3 × 1		
Ditto of inner rings	3 × ¾		3 × 1		
Usual pressure of steam in boilers	7 lb.	7 lb.		5½ lb.	
Corresponding ditto in cylinders					
Size of paddle beams cross ships	20 × 14		18 × 16		
Ditto of fore and aft paddle beams (9)	14½ × 7½ + 19½ × 10				

These sizes, being intended merely to show the proportional strength of the different parts of the engines, are frequently not taken with as great exactness as if they were intended for making drawings. This observation applies principally to the lengths of levers, rods, &c., but even these are probably never farther wrong than from ⅛ to ¼ inch. When the size of a journal is given, the diameter is put first and the length afterwards, thus,

Diameter Length
5 × 6. (— × 6) This mark would mean that the diameter is unknown. (5 × —) This mark that the length is unknown.

(1) 5½ and 4½ means that the web is 5½ in. thick at middle, and 4½ thick at ends.

(2) This size is necessarily very indefinite.

(3) In the Tar, (4,) 3-inch bolts go through the principal columns and the bottom of the ship, and there are 8 1⅛ bolts in other parts of each bottom.

(4) The length of the connecting rod of Braganza is given from centre of crank pin to upper end of the eye of the cross tail. The rest are given from centre of crank pin to end centre of side lever.

(5) Some doubt about the correctness of this size for the Fawcett.

(6) These sizes are approximations.

(7) The Tar's floats after she went to London were reduced to 1ft. 6in. in breadth, and put on in 2 halves, each 9 in. broad, one before, the other behind the arm, but they were too narrow; the engines went much too fast, and the vessel slower than before.

The Don Juan's floats were afterwards much reduced in breadth, I think to 2ft. 0in., or perhaps a few inches less.

(8) The arms of the Londonderry's paddle-wheel are 5 in. broad, where they fit into the cast-iron centre.

(9) In the Tar there are two beams bolted together, one 14½ × 7½, the other 19½ × 10.

MEMOIR OF ROBERT MUDIE, ESQ.,

LATE CONDUCTOR OF THE "SURVEYOR, ENGINEER, AND ARCHITECT."

It has seldom fallen to the lot of a biographer to narrate the life of so extraordinary a man as the subject of this brief sketch. If matchless force and vigour of intellect, if power and beauty of imagination, almost surpassing the bounds of sober belief, if the faculty of grappling with and comprehending the length and breadth of every science into which the human understanding has ever penetrated – if all these, united in one man, are sufficient to confer upon him the appellation of "great," the voice of all whom he has left behind to mourn his loss, and but too feebly to supply his place, will acknowledge, with one accord, that seldom has a greater spirit inhabited this earth than that which gave life and being to the mortal frame of Robert Mudie. In him genius has lost her darling child, science her most devoted pupil, nature her most enthusiastic worshipper; and although his memory will live for ever amid the glowing pages of those splendid works by which he has adorned the literature of his native country, yet will the rising generation feel, and deeply feel, the loss of one who as far exceeded his fellow men in the happiness and ease with which he communicated knowledge to others, as he himself surpassed all others in the capacity of acquiring knowledge which he himself enjoyed.

Our admiration for those transcendent talents and those profound acquirements which raised Mr. Mudie to the very foremost rank in the world of letters, is, however, appealed to in a tenfold degree when we view in him probably the most wonderful instance on record of that never-to-be-subdued genius, that innate nobility of mind, which, springing out of a very humble sphere of society, and crushing into dust all the artificial distinctions of birth and station, wealth, fortune, education, burst forth with an energy peculiarly its own, and rising above all opposition, planted its distinguished possessor upon an eminence, which few indeed of those upon whom every advantage has been lavished which this world affords can ever hope to reach. It is true there are many examples of great men arising in this way from obscurity, but amongst them all the subject of this notice is probably the most remarkable that ever ploughed his way into the world of letters.

He was a native of Forfarshire, and was intended by his father to follow the trade of a weaver; but, during the heavy hours that he was moving about the shuttle he contrived to hide a book, and every now and then "catch a glimpse of inspiration" from whatever odd volume he could obtain. His employment became at length so distasteful to his youthful impulses, that he one morning boldly inquired of his father, "Whether a man was obliged to be a weaver to make his way in life?" His father looked earnestly at him for a time, and at length replied: "Robert, you are not certainly obliged to be a weaver, but what am I to do with you? Your brother is slow at everything; and you are always trying at everything; I do not, however, think you are true to your trade, my lad, and I must seek something else for you." This promise on the part of his father instantly pointed out to him the path he himself would choose to follow, and, fortunately for the rising generation, he chose the paths of science and literature. In the opinion of all who know his writings he is incontestibly a hundred years in advance of the age in his knowledge of all matters in which his mind was engaged; and to show how profoundly he understood his subjects it is only necessary to state, that his book was always composed before one line was written. Hence it was, that there were scarcely ever any erasures in his manuscript, and he always taught his amanuensis as he dictated, for his subject and object were ever kept in view by his powerful reasoning, his ready eloquence, his extreme nicety of language, and his graceful and sounding periods.

His memory was so exceedingly retentive, that he could at all times ask his companion for any particular passage that he wished to quote, and tell him the particular page in which to find it; and such was the extraordinary intimacy he had with the sacred volume, that he could, without reference, quote any wished-for passage most accurately.

He came to London about the year 1820, and was for some time a reporter on the Morning Chronicle, and was selected as the one from amongst the other gentlemen to go to Scotland to write the description of King George the Fourth's memorable visit to the Scottish metropolis. In this he succeeded so admirably, that it was said that the Morning Chronicle went off "wholesale," in consequence of the proprietors having sent "a Scots raw recruit that was making some noise in the world." He laughed at this pleasantry, as he called it, and about five minutes after came from his study with the title of a new book; this was the celebrated and beautifully written work intitled "The Modern Athens," the first of his books that made any stir in London. "There," he said, handing the title to one that sat near him, "there is a book that shall make auld Scotia feel that her raw recruits can pay her back for the miseries she has inflicted on them, and very good-naturedly, too!" The book had a rapid sale, and so had every succeeding one of that stamp; but he soon after took a higher walk in the literary world, and united science with literature. In this department may be ranked the elegant volumes of the "British Naturalist," which work was projected by Mr. William Spooner, of the Strand; and, during a leisure day which he spent with Mr. Mudie in Surrey, their plans were concerted, and the book was produced in a short time, to the great satisfaction of the proprietor and the public.

In dictating, his constant practice was to walk about the room in an erect attitude until he came to some passage that he had previously deeply studied, when, all at once, his back would stoop, his face incline to the ground, and the tears would gush down his cheeks with powerful and not-to-be-subdued feeling. Nothing was new to him; every subject seemed to have been studied before he himself was aware of his own excellence. Such was the simplicity of his character, that his greatest love was centered in young children, and he used to converse with them as though they were old friends, and call them "the growing props of philosophy."

He was associated in the Inverness Academy with the celebrated Alexander Nimmo, where, strange to tell, he was elected Gaelic professor and teacher of drawing, at a time when he knew scarcely a word of the language; yet, such was the facility with which he could overcome any difficulty, that in a week or two he made himself quite equal to the appointment, and from that time kept it with credit and honour to himself, and to the entire satisfaction of the magistrates.

At the time of the Caledonian Canal being cut, and at the time when Telford was occasionally visiting the country, Mr. Mudie was constantly about, as he himself used to express it, with Mr. Nimmo and the Messrs. Hughes, for whom, to the day of his death, he entertained the sincerest attachment. He was very intimate with Mr. Macneil, and, indeed, with very many other distinguished men, who will dwell on his name with silence.

John Mudie, the father of Robert, was a fine old honest man, not rich, but entirely respectable, and was inclined to be poetical. The subject of this sketch was looked up to by the family, although the youngest child; and on one occasion his father brought him a volume of poems, which he wished to be printed. His son did not wish them to "see the light," and such was the opinion which the proud old man entertained of his son's judgment, that he took them back to his quiet home, to be seen no more.

He loved his mother with that excessive fondness which all great men have felt for their maternal parent. He did not believe in genius. "No man is born wise," said he. "The Almighty has given to each and all his creatures the same ability."

If we might be allowed on this point to differ from one who so well understood human nature,—we should point to himself as a remarkable refutation of his own doctrine; for, surely, there never existed so remarkable an instance of that heaven-inspired genius which falls to the lot of so few amongst the sons of earth.

Mr. Mudie's writings embrace the whole circle of the sciences, and he not only knew what had been done in every department of the School of Philosophy, but a comprehensive picture of what remained to be thrown open to the view of the rising generation, lay ever before him. The ninety volumes he has left behind him prove that he grasped his subject with a boldness, a judgment, a taste, that was his own, peculiarly his own. His style of composition was incomparably graceful,—in his ever-eloquent and thrilling periods, there was no wire-drawing tenuity of diction,—while all that he ever wrote in an eminent degree arrested the judgment, interested the feelings, and aroused the admiration of his readers.

Amongst the most interesting of his works may be mentioned, "The Modern Athens," "Babylon the Great," "British Natural History;" subsequent works were the "'Heavens,' the 'Earth,' the 'Sea,' and 'Air;'" the "Seasons;" "Man—Physical,—Moral, Intellectual,—Social;" "Popular Guide to the Observation of Nature;" History of British Birds," *(two very interesting books);* "Popular Mathematics;" "History of Astronomy;" the "Botanic Annual," &c. But the most important of his recent works were, "The World Described, Familiarly, but Philosophically," and the Letter-press to "Gilbert's Modern Atlas of the Earth;" and, it may be added, the maps of the latter important work are very much indebted to him for their geographical accuracy.

These, with his other numerous works, seem a great quantity of writing for one man to accomplish; but such were his industry and ability, that of our own personal knowledge we have known him throw off a volume in eight or ten days. As a specimen of that beautiful style of composition which distinguished the writings of Mr. Mudie, we subjoin the following from the introduction to his "*Botanic Annual*:"—

If pleasure, unmixed with forecastings of retributive bitterness, is sought; if the body is to be recruited after the exhaustion of disease; if the wounded spirit is to be healed after the anguish of privation or the agony of misfortune; nay, if there is any hope that reason shall resume its power, after the pressure on the mind had been more than its strength; the "joy that bringeth no sorrow," the medicine for the disease, the balm for the wounded spirit, the asylum for the wandering mind, are found no where but in the sunny glades, the green canopies, and the life-imparting breezes of nature. So also when the strength has failed, and the common occupations of life can no longer give pleasure; when wealth becomes uneasiness, honour a burden, the banquet palls on the appetite, and the ear is dull to the sounds of music, and the eye dim to all the panoply of grandeur; place but the sufferer in society upon a green slope, where the landscape spreads wide and full before him, with its clustering woods, its opening glades, its blue uplands, and its varied and varying lights and shadows, with its sparkling cataracts, its glittering streams, and its glassy lakes; with its flocks, its herds, and its wild animals, roaming from pasture to pasture, or bounding from cover to cover; with its flowers of every spot, and on every spray; its living inhabitants, from the eagle that dashes heavenward, defying the ardours of the sun, to the eel that leaves not the ooze at the bottom of the water, save to perform its curious migration to the sea; when the inspiring breath of the sweet south-west just puts the twigs and leaves into life, and the light summer clouds flinging their shadows, now here, now there, make the one view a thousand ere the throbs of a renovated heart have counted the half of that number; when, in short, all nature is beauty to the eye, music to the ear, essence to the smell, and life to the spirit—there comes a new lustre on the eye, a young perception on all the senses; the arteries have more elasticity; the whole system, that was withering in art, waxes green in nature; and even near the brink of the grave man feels a triumph over death—a consciousness of immortality which no scepticism can shake, and no mortal misery cloud.

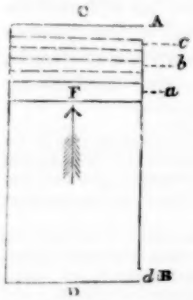
Who is there that can read this exquisite and brilliant passage without feeling himself elevated by the momentary association with that majestic intellect which gave to it form and expression. Who is there that feels not for its writer all that kindred sympathy which so impassioned an admiration of nature ever inspires. One is irresistibly led to inquire, whether he himself was permitted to close his mortal career amid those enchanting scenes of nature's loveliness, which no tongue has ever invested with half the charm which he himself threw around his most ordinary descriptions. The answer, alas, is a reproach to society, and to the nation—Robert Mudie's exhausted spirit was not permitted in its last hours to inhale those life-imparting breezes of nature, which, in his own words, would have inspired him with "a triumph over death—with a consciousness of immortality, which no scepticism could shake, and no mortal misery cloud."

He died, it is true, surrounded by a devoted family, but far, far from his own green slope, amid that exquisite landscape which no hand will ever paint again in such eloquent and truthful colours. The melancholy announcement of his death is simply this:—"At his residence, 19, Edward Terrace, Pentonville, Robert Mudie, Esq. aged 64." *Sic transit gloria mundi.*

THE SLIDE VALVES OF STEAM ENGINES.

We have much pleasure in presenting our readers with the following rules for determining the proportions of common slide valves, either long D valves or the short slide valves, with three ports in the cylinder face, when wrought by an excentric.

In such valves, if there is any overlap or cover on the steam side of the port at all, the steam is always cut off before the piston has completed its stroke. If, for example, C D be a steam cylinder, with a piston F moving upwards, the slide valve will shut off the steam that is entering at B, when the piston is at some point, *a*. When the piston has proceeded a little farther, as to *b*, the side valve will close the passage of the steam above the piston to the condenser, through the port A, and when the piston has got still nearer the top of the cylinder, as to *c*, the valve will open a passage to the condenser at the port B. It is, of course, a matter of importance, to be able to determine easily and readily at what part of the stroke each of these changes takes place, and what effect would be produced by any change in the overlap of the valve, or of the length of its stroke,—the only two dimensions which affect the times of opening and shutting the passages. For this purpose,



Let s = half the length of stroke of the piston (in inches.)

s' = half the length of stroke of the valve (in inches.)

t = that part of the stroke which is completed before the steam is cut off (in inches); that is, to *a d* in the figure.

t' = that part of the stroke which is completed before the exhausting port is shut; that is, to *b d* in the figure.

t'' = that part of the stroke which is completed before the exhausting port at the other end of the cylinder is opened; that is, to *c d* in the figure.

c = cover or overlap of the valve on the steam side.

c' = cover or overlap of the valve on the exhausting side.

Then the three following formulæ will determine, with great ease, the distance of each of the points, *a*, *b*, and *c* from *d*, for any dimensions of the valve.

(Note that: Sin.$^{-1}$ x means the arc whose sine is equal to x.)

$$t = s\left\{1+\cos.\left(2\sin.^{-1}\frac{c}{s'}\right)\right\} \quad . \ . \ . \quad (1)$$

$$t' = s\left\{1+\cos.\left(2\sin.^{-1}\frac{c+c'}{2s'}\right)\right\} \quad . \ . \quad (2)$$

$$t'' = s\left\{1+\cos.\left(\sin.^{-1}\frac{c-c'}{s'}\right)\right\} \quad . \ . \ . \quad (3)$$

The three following rules correspond to the above three foregoing formulæ.

Rule 1.—Divide the cover on the steam side by half the stroke of the valve. Find, by a table of *natural* sines, the arc whose sine is equal to the quotient. Take the double of the arc thus found, and subtract it from 90°. Find (in the same table) the sine of the remainder. Add 1 to the sine thus found, and multiply the sum by half the stroke of the piston. The product will be the space (*ad*) travelled over by the piston before the steam is cut off.

Rule 2.—Add the cover on the steam side to the cover on the exhausting side, and divide the sum by the length of the valve stroke. Find the arc whose sine is equal to the quotient. Take the double of this arc, and subtract it from 90°. Find the sine of the remainder, add one to it, and multiply the sum by half the stroke of the piston. The product is the space *bd*.

Rule 3.—Subtract the cover on the exhausting side from the cover on the steam side. Divide the remainder by half the length of the valve stroke. Find the arc whose sine is equal to the quotient. Subtract this arc from 90°, and find the sine of the remainder. Add 1 to it, and multiply by half the stroke of the piston. The product is the space *cd*.

N. B. All dimensions must be taken in the same measure, either in inches or in feet. Inches will be most convenient. The above rules and formulæ are constructed on the supposition, that the excentric is so placed as to make the valve just begin to open the steam port when the piston commences the stroke. If the excentric be placed so as to make the steam port be considerably opened, or so as to give a considerable lead, as it is called, the amount of the lead must be added to the cover on the steam side, in using any of the above rules or formulæ.

EXAMPLE.

Suppose the cover on the steam side of a D valve to be 2 inches, and on the exhausting side 1 inch, and the stroke of the valve to be 10 inches, and the stroke of the piston 72 inches. Then we shall have $c=2$, $c'=1$, $s=36$, $s'=5$; and by the formulæ

$t=36\{1+\cos.47°10'\}$ $t'=36\{1+\cos.34°56'\}$ $t''=36\{1+\cos.11°33'\}$

$=60.48$ inches $=65.73$ inches $=71.28$ inches.

So that the steam is shut off when the piston is 60½ inches from the bottom of the cylinder; that is, *ad* is equal to 60½, *bd* is equal to 65¾ inches, and *cd* is equal to 71¼ inches.

SOUNDING LINES.

Sounding lines should be made of strong pliable cord, known as "lead line," divided into feet by different coloured rags, or other marks. The lead, fastened at one extremity, is shaped like the frustum of a cone, with the base hollowed out to hold some grease, to which the sand or mud at the bottom may adhere, serving thus to show the probable nature of the anchorage. Lines are used differing in length and strength, and leads differing in weight, according to the depth of the water in which the casts are made. The line, especially when new, must be occasionally compared, during a day's work, with a standard measure always at hand, as they are liable to great and sudden changes. It is almost needless to observe, that in open waters an experienced leads-man must be employed, whose reading of the depths should nevertheless be frequently checked. When the soundings are deep, the boat's way must be stopped at each cast, in order that the depth may be measured in a vertical direction. On shallows or reefs near the surface, and generally in all anchoring grounds of small depth, where accuracy is consequently of the utmost importance, sounding rods, divided into feet, and weighted at the extremities, may with advantage be substituted, to obtain greater correctness. The grease let into the hollow base of the lead, or the "arming," shows

the nature of the surface of the bottom; but, before we pronounce upon the quality of an anchorage, we should likewise know, if possible, the nature of the material for some depth under the immediate surface. This object is accomplished by means of a lance-shaped pike, of a length and weight proportionate to the depth to which it is desired to penetrate beneath the surface. The part below the lead is indented in the same manner as a rasp, and the indentations on its surface bring up specimens of the deposit or formation traversed by the instrument, thus indicating in some degree its nature. If the pike be impeded in its progress by rock, its bent or broken point, when brought up to the surface, gives evidence of the fact. Additional value may, by such means, be given to the soundings: and in the field-book, at the entries of the nature of the bottom, a mark should be made to distinguish the data obtained by this instrument from those obtained by the common lead.

[From *Williams's Practical Geodesy*, a book which we strongly recommend to the attention of our readers, as a work of great value and originality on the most important branches of land-surveying and field-engineering.]

INSTITUTION OF CIVIL ENGINEERS.

May 10th.—A PAPER was read descriptive of Messrs. Marshall's new flax mill at Leeds, by Mr. Combe. This mill consists of one room, 132 yards long by 72 yards wide, covering nearly two acres of ground: the average height is 21 feet. The roof is formed of brick groined arches of 36 feet span, supported by cast-iron pillars; an impermeable coating of coal-tar and lime is laid over the arches, and upon that is a layer of soil, 8 inches thick, sown with grass. This immense room is lighted and ventilated by a series of sky-lights 13½ feet in diameter, one at the centre of each groin; throughout, beneath the building, extends a cellar, containing the shafts for communicating the motion from a pair of 100-horse power steam-engines to the various machines in the mill. The flues and steam cases for warming and ventilating, and the revolving fan for urging the air into the room, are also placed there, with the gas and water pipes, and the rest of the space is used as a warehouse. All the details of the construction of this extensive building were given, with the cost of it, which appeared to be no more than that of an ordinary fire-proof mill. The advantages of this description of building were stated to be, the convenience of supervision, the easy access to the machines, the power of sustaining an uniformity of temperature and moisture, the absence of currents of air, and several points of minor importance. In the discussion which ensued, all these advantages were fully confirmed by several members, but particularly by Mr. Smith, of Deanston, who originated this mode of construction for a weaving shed, of the extent of half an acre. Mr. Marshall saw this shed, and, although the plans for mills of several stories high were made out, he abandoned them, and adopted the present plan, which had been completely successful. The adoption of similar constructions for machine manufactories, and even for agricultural buildings, was strongly urged, on the ground of the advantages arising from concentrating all the processes under the supervision of one person, and the economy in moving heavy masses. Arched roofs were stated not to be more expensive than wood and slate coverings, and to be quite as sound when well executed; and of their greater durability there could not exist a doubt.

HEREFORD CATHEDRAL.

DR. MEREWETHER, the Dean of Hereford, has addressed an eloquent appeal to the British public on behalf of the venerable cathedral of that city, which, it appears, is greatly in need of repair, in order to avert the fall of the great central tower. The following particulars are taken from the Dean's statement:—

The Cathedral Church of Hereford is one of the most interesting in this kingdom. A Bishop of Hereford was one of those seven of the original Anglican church, who, with their metropolitan of Carleon-upon-Usk, met Augustine in conference, in the year 596, and maintained the independence of their church.

Its fabric is remarkable for its venerable antiquity: it contains the ashes and monuments of thirty-seven bishops; whilst it possesses specimens of every transition of style, from the early Norman, if not Anglo-Saxon, down to the latest period of sound Ecclesiastical architecture; and from this very cause it is that its present danger and its difficulties arise, especially in the massive central tower, which has been, and, in spite of such precautions as the most anxious care could devise, may be still, in imminent danger. This majestic structure is of the early decorated style, and was built about the year 1280, on the ancient Norman piers and arches, which now indicate symptoms of awful crushing and splitting, under its enormous weight.

The greater part of the cathedral, except the exquisite lady chapel of the early English style, is of the Norman character, on which additions of later styles have been erected; and the general failure of the substructure is so formidable and extended, that it is quite beyond the resources of the cathedral establishment itself, to meet the outlay which is necessary to preserve this venerable national monument from ruin.

In the year 1786, a noble tower, of the Norman style, which had been erected at the western extremity of the cathedral, by Bishop Giles de Braos, in 1199, fell, and not only destroyed a considerable portion of the nave, which led to a reparation in a different and debased style, but entailed upon the fabric funds a heavy incumbrance, which has not yet been reduced below £9000, notwithstanding continual sacrifices made by the members of the body for that purpose.

REVIEW.

Gandy and Band's Windsor Castle. Part 7.

MERELY remarking for the present that this Part contains two pictorial views, one of a part of the North Terrace, the other of Henry III.'s Tower, and three elevations of different portions of the quadrangle, we shall reserve our comments on the work generally, until it shall have been completed, or rather, brought to a close, in the next and last number. That is to contain an "Historical Account,"—not an Architectural one—of the castle; and as we understand that it is to be from the pen of John Britton, we can also understand pretty well beforehand what sort of an account and history it is likely to turn out. It will be in his usual egotistical strain, no doubt; verbose and pompous, with a touch or two of the pathetic and lachrymose. It is possible, however, that by this time Mr. Britton may have unlearnt some of his silliness, and have learnt to speak a little more to the purpose, and be able to show that he has some distinct ideas of his own on the subject he is talking about. Perhaps he would have acted more discreetly

had he laid down his pen for ever, after finishing his architectural dictionary—a production that would almost disgrace a schoolboy.

Instructive Examples in Architectural, Engineering, and Mechanical Drawing. London: John Weale, 1842.

THIS work, which comprises thirty folio plates, accompanied by a descriptive letter-press, is intended for the use of professional students, and of the architectural and engineering classes in the various schools and colleges of London, Durham, Dublin, and other parts of the kingdom.

The examples are exceedingly well adapted to instruct and improve the student in the style of drawing which he will principally be required to practise, namely, that which is founded on the parallel projection of objects. A good description of this and the other styles of linear drawing is given in the introductory part of the letter-press. The connection of isometrical projection with the ordinary engineering and architectural style of drawing is more clearly explained than we ever remember to have seen in any other work. The author treats the isometrical projection as a branch of the true parallel projection, and explains this, by means of the representation of a cube, in a manner so clear as to be at once understood by every draughtsman.

It is almost impossible to give an extract from this book which would be understood without the plates; but we take leave confidently to recommend it to all who are endeavouring to acquire a knowledge of geometrical drawing. We should also imagine the work will be found extremely useful in the offices of architects and engineers, for whose pupils the plates will serve as excellent drawings to copy from.

SHORT NOTES.

PROPOSED RAILWAYS.

THE Northern Union (Newcastle and Darlington Junction) Railway consists of a main line of 7 miles and 110 yards in length, from Shincliffe to the Durham Junction Railway, and of a branch 2 miles and a quarter in length, from the main line to the city of Durham. The proposed capital of the company is £500,000, and the amount of loans they are empowered to raise by their bill now before parliament is £166,000. The engineers examined in support of the bill before the House of Commons Committee, were Messrs. Robert Stephenson, Nicholas Wood, and Thomas Elliott Harrison.

The Warwick and Leamington Union Railway is a short line of 8 miles and 5 furlongs, the amount of capital £130,000, in addition to which the company is empowered to raise £43,000 by loan. The line extends from the towns of Warwick and Leamington to Coventry, where it forms a junction with the London and Birmingham Railway. Engineer, Thomas Jackson Woodhouse, Esq.

The Yarmouth and Norwich Railway is 20 miles 44 chains in length, and the estimated cost is £150,000, the company being also empowered to raise a further sum of £50,000. The whole number of shareholders is 148, of whom 105 may be considered as having a local interest in the line. It appears that a line between Yarmouth and Norwich has been already sanctioned by parliament as a part of the Eastern Counties line; but the compulsory power then granted to take lands having since elapsed, a new company has been formed, to whom the Eastern Counties Company has abandoned their right. The engineers examined in support of the new line were Messrs. George Parker Bidder, and James Routh.

TAX ON RAILWAY PASSENGERS.

IN an able pamphlet on this subject, which has been addressed by Mr. Lang to the Chancellor of the Exchequer, the writer very clearly shows the hardship inflicted by the present mode of taxation upon those railway companies who have done most to develop a third-class passenger traffic. It appears that the tax at present paid by all railway companies is ¼ of a penny per mile on each passenger, whether travelling in a first, second, or third class carriage, so that the tax paid by the London and Birmingham Company for their first-class passengers, whose fare is 3½*d.* per mile, is no more than that paid by the Glasgow and Paisley Railway Company for their third-class passengers, whose fare is one halfpenny per mile. In the former case the government exacts less than 4 per cent. of the gross passenger receipts, in the latter case the tax amounts to 25 per cent. A number of comparisons similar to this are made by Mr. Lang, to shew the unequal pressure of the tax upon the railways which depend principally for their traffic upon the poorest classes, and where, consequently, the fares are low, and the greater number of passengers travel in third-class carriages.

The proportion of passengers carried on the following railways is as under:—

Grand Junction . .	100	1st class to about	6½	3rd class.
Great Western . .	100	. . .	6¾	
South Western . .	100	. . .	14	
Hull and Selby . .	100	. . .	350	
Glasgow and Ayr .	100	. . .	360	
*Glasgow and Greenock	100	. . .	360	2nd class.
Manchester and Leeds	100	. . .	900	
Newtyle and Cupar-Angus	100	. .	1,400	
Dundee and Arbroath	100	. .	1,700	
Glasgow and Garnkirk	100	. .	2,300	
Arbroath and Forfar	100	. .	4,100	
Dundee and Newtyle	100	. .	9,000	
Liverpool and Manchester	100	. .	——	
Edinburgh and Dalkeith	—	. .	221,459	2nd class.

The following Table exhibits the amount of duty paid by different railway companies on their gross receipts from passengers.

	£	s.	d.	
London and Birmingham	4	14	5	per cent.
Grand Junction . .	4	17	6	
South Western . .	5	15	0	
Great Western . .	5	16	0	
Manchester and Leeds .	7	18	0	
Hull and Selby . .	9	7	8	
Glasgow and Ayr . .	10	0	0	
Dundee and Newtyle .	10	0	0	
Dundee and Arbroath .	11	2	0	
Brandling Junction . .	11	10	9	
Glasgow and Greenock .	12	16	10	
Glasgow and Garnkirk .	14	14	0	
Monkland and Kirkintilloch	17	0	0	
Edinburgh and Dalkeith .	17	0	0	

The above statements, which are taken from Mr. Lang's pam-

* This railway is prevented by the tax from running third class carriages.

phlet, pp. 7 and 8, are certainly very strong in favour of the view which he has espoused; and when it is considered in addition, that the railways, where a large third-class traffic exists, are almost exclusively those which benefit the labouring population; and, further, that almost all the railways which have endeavoured to maintain a third-class traffic, have suffered a depreciation of their shares to an amount greatly below par, while the great lines of the south, affording less accommodation to the public, enjoy great prosperity, there can surely be no reasonable ground for opposing what Mr. Lang proposes, namely, a fixed per-centage of about 6 per cent. on the gross passenger receipts of all railway companies, in lieu of the present mileage duties.

MAIL CONVEYANCE FROM CREWE TO CHESTER AND BIRKENHEAD.

THE correspondence relating to a long dispute on this subject, between the authorities of the Post Office and the directors of the Grand Junction Railway Company, has been lately published. It seems that the Grand Junction Company originally possessed the undivided command of the mail and other Irish passenger traffic from Birmingham to Liverpool. Since the establishment, however, of the Chester and Crewe line, and of its continuation to Birkenhead, on the south bank of the Mersey, the Post Office has directed the removal of the Irish packet station to Birkenhead, and has required that a mail train should be provided at certain times to run from Crewe to Chester, and from Chester to Birkenhead. About May last year, the Grand Junction Company became proprietors of the Chester and Crewe line, and then commenced their opposition to the demands of the Post Office, with reference to the establishment of the Irish mail trains otherwise than by way of Liverpool. The Postmaster-general having steadily exerted the authority which he possesses by act of Parliament, the question became, What was the amount of compensation to be paid to the company for the accommodation thus demanded by the Post Office. The decision of this was referred to the arbitration of Lieutenant Harness, R. E., on the part of the Post Office, and Joseph Locke, Esq., on the part of the company. These gentlemen not being able to agree, referred the decision to J. Wilson Patten, Esq., M.P., as umpire, to whom they each made a statement, explaining their view of the case. Lieutenant Harness is of opinion, considering the obstacles which the Company had thrown in the way of the Postmaster-general, and the injury which he states has been sustained by the revenue in consequence of the company's arrangements preventing passengers from proceeding by the Government mail boats to Ireland, and for some other reasons, that the sum to be paid for the conveyance of the mail should be merely nominal, or about 2*s.* or 3*s.* per day.

Mr. Locke, on the contrary, denies the charges of Lieutenant Harness against the company, and makes two statements of the expense of working and locomotive power, the least favourable of which shows that not less than £11 13*s.* 8*d.* should be paid to the company for the service in question.

Mr. Patten, taking into his consideration these opposite statements, together with other documents laid before him, decides that £7 4*s.* 0*d.* is a proper sum to be paid by the Postmaster-general, for the services which he requires the company to perform.

Such is the final decision of this affair—one with which the Company appears to be very much dissatisfied, and of which they complained to the Postmaster-general, but his lordship has very coolly declined to disturb the award.

WOODEN PAVEMENTS.

THE rhomboidal blocks introduced by the Count de Lisle, embrace the peculiarity of a system of wedging, dovetailing, or mortising and tenouing, which gives to the whole mass of the pavement a degree of stiffness and tenacity superior to the other forms which have hitherto been tried. The hexagonal prisms appear to require more care in accurately fitting and fixing them. It is to be regretted that due attention has not hitherto been paid to this important point, and also that, in the first trials of the prisms, the foundation on which they were laid was very imperfectly prepared. The proprietors of both kinds of wood paving adopt at this time a very expensive foundation of gravel and Roman cement. This occasions a very unnecessary expense, because a good lime concrete of the same depth would answer just as well, with only this drawback, that it would require a longer time to set hard. This, however, could form no serious objection, where a considerable extent of the paving had to be laid down at one time.

We observe a new kind of wooden paving in progress near St. Clement's Church, in the Strand. The blocks are of larger size than usual, and no concrete or other artificial foundation is prepared for them. The idea in this experiment is obviously, that the large area on which each block rests, will not admit of the same partial and unequal settlements to which the small blocks are subject. We predict that this notion will prove erroneous, unless it has previously been ascertained that the whole foundation is equally firm and solid in every part. The French have a method of thoroughly ramming or pounding with heavy rammers the whole area on which any structure producing a pressure on its base is intended to rest. This practice might be advantageously followed in the case of wooden pavements, as it would serve to detect every spot of a spongy or soft character which might be expected to yield when the traffic of horses and wheeled carriages came upon it. The unsound parts, thus detected, should be made of equal solidity with the rest of the base, by means of dry gravel, broken stones, concrete, or other expedient which the case may require. It should be borne in mind that, if no irregular settlement take place in wooden paving, it will last an immense time; and that, on the other hand, the best-finished piece of workmanship is readily destroyed by unequal settlement of the blocks. It follows, therefore, that great attention should be paid to the foundation on which they rest. If it were possible to lay them upon a foundation either perfectly unyielding, or one which should yield equally in every part, it is evident that no unequal settlement would take place. It is this theoretical excellence which should be aimed at—an excellence which, though it cannot be perfectly reached in the actual construction, may yet be much more nearly approached than in some of the earlier attempts at wooden paving.

ENCROACHMENT OF THE SEA AT WORTHING.

IN consequence of the rapid encroachments made by the sea upon this town, to an extent which threatens altogether to destroy it, unless some means be taken to prevent it, subscriptions have lately been made in the town and neighbourhood, in order to accumulate a fund for the purpose of adopting precautionary measures against further encroachments. We understand the subscriptions already considerably exceed £1000.

MR. SMIRKE'S REPORT ON THE RESTORATION OF YORK MINSTER.

"24, *Berkeley Square*, 17*th March*, 1842.

"DEAR SIR,

"In complying with your request that I should report to you, for the information of the Committee for the Restoration of York Minster, upon the present state of the works, and upon the works remaining to be done, I think it will be expedient in the first place to enumerate in detail all the repairs that have hitherto been effected, although the Committee are already well acquainted with them, for should it be thought proper to make my present communication public, such a statement would, I think, be very naturally expected.

"I have the satisfaction of being able to say that the data upon which the estimate of my brother, Sir Robert Smirke, contained in his report of the 25th of June, 1840, was founded, have proved to be in almost every respect correct. The interior of the south-west tower is the only part where the fire has been found more destructive than was at first supposed.

"A great many square yards of masonry that appeared to be only superficially affected, proved, on that close examination which was at first impracticable, to be deeply injured. Stones apparently only discoloured were found to be split by the heat through their whole depth. Had only the surface of these been removed, and a thin casing of ashlar been placed against them, the repair would have been a far more rapid and less expensive work; but it would have, by no means, been a faithful restoration of the walls to their original state.

"The restoration of the interior face of the tower has been completed, and reaches, with only partial exceptions, from beneath the floor of the clock-chamber to the summit, an extent of about 1100 square yards.

"Each side of this tower was seriously rent through, new cracks having been formed and old cracks widened by the expansion arising from intense heat. All these cracks have been carefully cut out, and new sound stones inserted.

"The Newell stair at the north-west angle was in two places completely broken through, and become utterly impassable. This has beeen thoroughly restored and rebuilt, and 50 new steps introduced.

"As the tower was permanently expanded by the fire, and the old cracks at the west end of the nave were much increased in width, I thought it expedient, in order to give stability both to the tower and the west wall, to cramp the whole together by two strong iron ties, extending from the south side of the south-west tower across the west front to the north of the north-west tower; two other cross ties of iron connect these on the north and south sides of the north-west tower. All these bars are strongly wedged together, and are secured to very large blocks of Gazeby stone, worked into the body of the masonry. Thus the four sides of the damaged tower are bound together, whilst the tower itself is firmly united to the west front and to the tower at the opposite angle.

"The battlements on the top of the tower have been, wherever damaged, taken down and restored.

"A new roof of iron to the tower has been fixed and covered with lead.

"A new floor has been formed at the level of the bells, consisting of stone arches, springing from cast-iron bearers; and a floor of thick oak planking has been laid to receive the frame-work of the bells.

"A new floor has been formed for the ringers in the chamber underneath, and another new floor has been formed at the proper level for the clock. Both of these floors are of five-inch York landings, laid on cast-iron bearers.

"The tracery of the four belfry windows is entirely new; also much of the jambs of the windows.

"The louvres have been formed of slabs of half-inch Welch slate, let into grooves cut in the tracery.

"The four lower windows level with the clerestory have also required the jambs to be partly rebuilt, and the whole of the tracery new. In executing all the above tracery the most scrupulous attention has been paid to follow in every respect the original design. The contract for the glazing of these windows has been made, and is now in the course of completion, including that towards the north looking into the nave, which, previously to the fire, was bricked up, but which was, beyond any doubt, originally glazed.

"Some of the external perforated battlements of the south and east windows on this level, having been damaged by the fire, have been restored.

"The glazing of the lowest window towards the south was destroyed at the fire, and is now being restored.

"This completes the entire repair of the south-west tower.

"In executing all this masonry, the stone principally used has been that from Huddlestone, of which about 670 tons have been worked up. For purposes where the utmost possible strength was required, Gazeby stone has been adopted, and of this 218 tons have been used. The mortar has been made of calcined Huddlestone stone, and proves to be of the very best quality.

"In setting the work, stone dowels and iron or copper internal cramps have been used throughout; external cramps having been everywhere avoided when possible.

"I can with confidence invite the most critical examination of the execution of this masonry, which I believe to be in many respects superior to the old work.

"The remaining work which I have to specify as completed is the roof of the nave, which is wholly new.

"It is constructed of well-seasoned Memel oak, covered with thick cast lead, laid on two-inch oak planks. The gutters are of lead, laid upon a hard indestructible bed of mastic.

"I believe every practical eye will be satisfied, that this roof is executed in a manner worthy of the building of which it now forms a part.

"The masons are at present engaged in making good the surface of the masonry under this roof, and restoring the wall ribs that will form a part of the future vaulting; but, from the cause with which you are but too well acquainted, our operations are now limited, and must very shortly be brought to a close.

"The whole cost of the above works, including materials and every incidental expense, has amounted to about 13,300*l.*

"The roofs of the nave and of the south-west tower, the iron work for the three floors in the tower, and the glazing of the windows, have all been executed by contract, the lowest offers being in each case accepted. The stone, timber, and all other materials used in day work, have been charged at prices which were previously arranged, and which I consider the lowest that can fairly be allowed. A great weight of old iron and lead, resulting from the ruins, has been advantageously used in executing the new works, and I can confidently say, that throughout the whole restoration hitherto effected, the injunctions of the committee that the utmost possible attention should be paid to economy in every part of the work have been rigidly and faithfully attended to.

"I now proceed to specify the works of restoration which still remain to be done.

"The whole vaulting of the nave (exclusive of the aisles) is yet to be constructed. The few fragments that have been spared by the fire, and the various careful measurements and drawings that have been formerly made of this vaulting, will render it an easy task to restore it with all its ribs and bosses exactly to its original form.

"A portion of the roof of the south aisle at the west end was burnt, and requires to be rebuilt.

"The lower part of many of the stone piers of the nave is damaged by the fire, much of the masonry of the smaller shafts of these piers is flaked off, and other parts are so far calcined as to be unfit to stand. I propose to cut out all defective stones, and replace them with new, closely bedded and jointed, and cramped to the old work.

"The carved work against the walls under the windows of the south aisle at the south-west angle, has been mutilated by the effects of the heat, and by the falling of the burning timbers, from the interior of the tower. This requires restoration by the cutting out of the broken stones, and the substitution of new.

"The interior carved work about the principal western entrance has similarly suffered, and requires the same renovation.

"A new oak door of suitable character is necessary for the central west door-way, and for that under the south-west tower.

"Many of the black and white flags forming the pavement of the nave have been broken by the falling in of the roof and vaulted ceiling. These I propose to take up and relay with new.

"Some of the stained glass in the clerestory of the nave was damaged by the fire; this of course requires reinstatement.

"I have now, to the best of my belief, specified every work that is necessary in order to restore the fabric exactly to its original state previously to the late fire.

"My estimate of the cost of the whole of the above remaining works amounts to about 9000*l.*, including every contingent expense, except the remainder of the peal of bells, which are estimated at about 1,200*l.*

"I propose to have the whole of the vaulting executed by agreement for a fixed sum. The new doors, and also the reinstatement of the glass, can with propriety be executed by previous contract, but the repair of the masonry will be done best by day-work. I pledge myself to exercise the same scrupulous economy as hitherto, and it will be my anxious aim to complete the whole cost of the restoration within the sum originally estimated, which there appears to be now every probability of my being able to do.

"I am, Dear Sir,

"Yours very faithfully,

"SYDNEY SMIRKE.

"Rev. S. Creyke, &c., &c., &c."

FURTHER DETAILED REPORT OF MR. SMIRKE UPON THE GENERAL STATE OF THE FABRIC, AND THE COST OF THE REPAIRS NOW REQUIRED.

"24, *Berkeley Square, March 29th*, 1842.

"SIR,

"In compliance of the instructions with which I was honoured by the Dean and Chapter on the 16th ult., that I should report in a detailed manner upon the repairs required at York Minster—distinguishing such as are of pressing importance from those of a less urgent nature, and stating the probable cost thereof—I beg to state, after a careful survey of the whole fabric, that it appears to me expedient, in enumerating the various repairs required, to class them under three different heads, viz:—1st.—The repairs that are urgently required for the present safety of the building. 2nd. The repairs of works which are fallen into decay, but which are yet not in immediate danger. 3rd. The repairs which, however desirable for the dignity and character of this great national monument, may nevertheless be regarded only as ornamental restorations.

"I proceed, therefore, in conformity with this arrangement, to specify the first class of repairs.

"The most considerable work under this head is the roof over the centre aisle of the *North Transept*. The carpentry of this roof is no doubt part of the original structure of the 13th century; the timbers are of oak and extremely heavy. There is no tie beam, but there are two collar beams, far above the feet of the rafter, and halved and pinned to them with wood pins, many of which are decayed. No iron straps, ties or bolts have been used. Owing to this construction of the roof, and to the gradual effects of time, the roof is now in a very critical state; two of the trusses are broken, some of the timbers are split, and many are dislodged from their original and proper bearings; many of the main beams are decayed, especially at the ends which bear on the walls. The consequence of the above defects is, that the roof has thrust the walls from their vertical position. The western triforium now overhangs in some places nearly 5 inches in 7 feet, and, although it has probably long been in a defective state, it is certain that the evil increases; for the masonry of the western triforium was repointed and coloured about three years ago, and very conspicuous cracks have since appeared. Nor can it be otherwise, as many of the rafters of the roof, having, from the causes above described, ceased to be retained by any tie, are of course always pressing laterally against these walls. From the partial sinking of the roof, the slates cannot be laid close and flat, and are therefore frequently removed by the wind—an evil which is increased by the slightness of the battens, which are not of strength enough securely to hold up the slates.

"Such being the state of this roof, there is no doubt that on every occurrence of a violent storm, the north transept is in imminent danger; for the falling-in of the roof would involve the ruin of the vaulting and much of the masonry. I recommend, therefore, that this roof be removed, and a new one be substituted, in some respects similar to that over the south transept, which was put on, I believe, about 70 years since, and stands well; and I would recommend the use of lead or copper for the covering instead of slates. Whenever this repair is effected, the masonry of the triforium should be reinstated into as nearly vertical a position as may be found practicable, and properly tied together. The whole of the west side of this transept leans to the north, which makes the leaning over of the triforium towards the west so much the more dangerous.

"The three pinnacles of the buttresses on the *south-west side of the choir* are in a state requiring speedy attention; the stone work of all three is so split and decayed that in case of strong winds from the south or south-west their fall must be apprehended—an occurrence which might be attended with very injurious consequences, on account of their great dimensions.

"The parapet connecting these buttresses is worn away, so as to be in some places perforated, and the rest is in so feeble a state, that were some of the stones of the pinnacles to fall on it, the whole would give way.

"I have further to state, that the tracery of the most southern window of the *vestibule* to the chapter house is in a ruinous state; its sheltered position has hitherto saved it from destruction, but on a close examination it will be found that, partly from the exfoliation of the iron saddle bars, and partly from the crumbling away of the stone itself, the whole is in a most precarious state, and must be expected soon to give way.

"Both this tracery and the masonry previously described should be at once taken down and restored.

"I now proceed to specify the second class of repairs.

"CENTRAL TOWER.

"There are various cracks in the main walls which require to be made sound, by inserting new stones where broken, and by pointing up the open joints. The parapet also requires repair and re-pointing. The lead-work of the roof is very old and defective, owing partly to the effects of time, and partly to very inconsiderate mutilations by visitors. The lead should be taken off, recast, and relaid upon new oak boarding; and the gutters laid (as those recently formed for the nave) not upon boarding, but upon a hard level bed of mastic.

"The main girders, which support this roof, and are of enormous weight, are in some cases decayed at their ends, and have been supported by braces of fir, some of which appear to be dropping from their place. The repair of these girders should not be long delayed. Some cast-iron shoes should be fixed to receive their feet where decayed, and strong iron ties to keep together the fractured masonry of these walls are desirable.

"SOUTH TRANSEPT.

"The roof is firm and sound; but the gutters are in a defective condition, and should be relaid with new lead, otherwise the constant leakage now taking place will destroy the wood-work near the walls.

"THE CHOIR.

"Besides the pinnacles and parapet already alluded to in the first class of repairs, there are many parts of the exterior masonry requiring early and particular attention. The other pinnacles, both on the north and south side, are partially dilapidated, and stand much in need of repair; the fractured and decayed stones should be replaced with new, and the whole repointed and secured with new cramps. The external screen-work of the clerestory is so decayed that portions of it must soon be in ruins; several large stones appear to be about to fall on the roof of the aisle. The corresponding parts on the south side were substantially restored after the fire in 1829.

"THE NAVE.

"The lead work of the roof of the north aisle is very old and defective, and requires considerable repair; the gutters should be taken up, and the lead recast and relaid upon mastic or slate. The parapet of this aisle stands much in need of repair; the joints are decayed, and wet is constantly penetrating into the interior of the wall; the broken and decayed stones should be removed, and the whole thoroughly repaired and repointed.—The heads of the buttresses are in the same defective condition, and should also be repaired. The roof of the south aisle is in a still more dilapidated state. The carpentry is ill-constructed, owing to the absence of tie-beams, whereby the braces thrust injuriously against the south wall of the nave, above the triforium; some of the timbers also are decayed. This roof, one end of which was destroyed by the late fire, ought to be reconstructed upon a better principle, adopting trusses similar to those used at the late restoration over the choir and aisle; the lead should be recast and relaid of a proper substance, making good the deficiency with new. In constructing this roof much of the old timber will be again serviceable. It is greatly to be desired that the repairs of the roofs and parapets of these two aisles should be soon carried into execution.

"The tracery of the *south clerestory* is in a very mutilated condition; these windows are exposed to the severe weather, and the exterior is perishing; some of the mullions have lost half their substance, and the exfoliation of the iron saddle bars is expediting the decay of the stone, which is unfortunately not of a durable nature. Many years ago the renewal of this tracery seems to have been undertaken, and one window was completed; if the remaining six windows are not soon restored, they will become dangerous. In executing this and all other new masonry, Huddleston stone should be used for outside work, in preference to the Tadcaster, which time has shown to be of very inferior quality.

"NORTH-WEST TOWER OF NAVE.

"There are some considerable fractures in the main walls, which require to be repaired in the manner described for the central tower; much of the exterior masonry should be repointed, and some broken stones replaced. The lead of the roof is much decayed and mutilated, and lets water through in various places; it should be recast and relaid upon new oak boarding, the present boarding being in many parts rotten. The gutters, as before recommended, to be laid, not on wood, but on slate or mastic. The louvre boarding of the belfry requires repair; rain and snow drift in at various places; it is much to be desired that slate instead of wood be used for these louvres, as recently done in the belfry of the south-west tower. The original floors of this tower are entirely gone. It would add much to the future security of this tower if a stone floor with cast-iron girders were introduced near the middle, similar to those recently constructed in the south-west tower.

"THE SOUTH-WEST TOWER.

"Every part of this tower damaged by the late fire is now completely reinstated, but the south-east angle buttress, the upper part of which has separated from the main wall, and inclines forward. It ought to be reinstated, and firmly cramped to the wall, so as to become permanently connected with it.

"THE CHAPTER-HOUSE AND VESTIBULE.

"The parapet of the former will soon be in a ruinous state if the stone work is not attended to; those parts where the stones are much decayed should be renewed, and the whole carefully pointed. Every pinnacle also requires to be repaired—there are none that are not more or less defective, and two should be wholly taken down, and rebuilt with new stone. Besides the window tracery in the vestibule, already described as dangerous, the adjoining window towards the north, unless soon repaired, will fall into an equally bad state.

I now proceed to specify the third class of repairs. There are many evidences of decay in the exterior face of the east end wall of the choir. The north pier of the *Great East Window*, with its buttress and the perforated battlements, is in a state of general decay; the whole should be restored with new work, as was formerly done on the south side of the window. The spire of the north-east pinnacle, now wholly wanting, should be rebuilt, so as to correspond with the south-east pinnacle.

"The four pinnacles at the south front of the *South Transept* are for the most part of modern workmanship, although in a very bad state of repair. I cannot, however, recommend their restoration, for they are very incongruous in style, and injurious to the effect of this beautiful façade; they should be taken down and replaced by pinnacles in unison with the rest of the transept, of which many beautiful examples are furnished by the contemporary portions of Salisbury, Peterborough and other cathedrals.

"The pinnacles of the three angle buttresses at the northern extremity of the *North Transept* are now wholly wanting, and the restoration of these is greatly to be desired; one of the most beautiful and picturesque views of the Minster is that from the north-west, and it is easy to conceive how greatly the effect would be enhanced by thus restoring the original design.

"In the interior of the Minster, the ornamental arches under the windows of the nave, especially towards the west, are much impaired; the late fire severely injured those arches at the south-west angle of the nave, but the injury from that cause did not extend far. Although not affecting the real stability of the fabric, these defects, being near the eye, convey an idea of great dilapidation, and the reinstatement of this masonry is, therefore, a very desirable work.

"I now beg leave, according to your directions, to report to you *estimates for these various works.*

"It is obvious that many of the repairs are of a nature not to admit of being estimated with exactness, but the recent restorations at this minster afford some data upon which reliance can be placed; and I, therefore, feel myself justified in stating that the expense will not exceed the following estimated amounts:—I estimate the probable cost of executing the repairs classed under the *first* head at about £6,200; the probable cost of the *second* class of repairs I estimate at £12,500; and those of the *third* class at £9,500; making the total expense a sum not exceeding about £28,200, exclusive of the cost of completing the execution of those repairs that were rendered necessary by the late fire.

"It must not be supposed that the Minster can be restored throughout to a perfect state for this sum, for, on account of the perishable nature of the stone used, there is scarcely a moulded or carved member throughout the fabric that is perfect, except of course those parts that have been restored by modern hands; it would be, therefore, useless to contemplate the present restoration of all these works; they are such as may well be left to be gradually effected by the permanent employment of a few good masons, judiciously directed.

"This appears to have been the course followed by the Dean and Chapter previously to the fire in 1829; a restoration has been effected with great care and fidelity of the exterior masonry along the south side, the west end, and the north side of the nave and transept, as far as the vestibule leading to the chapter-house, where commences the masonry, which, as stated above, is in a very decayed and critical state.

"It remains for me now to comply with the desire of the Dean and Chapter that I should report to you upon the practicability of *making an effective provision against future accidents by fire* in the Minster.

"It seems obvious that the most important precautions to be taken are, first, the provision of a sufficient number of reservoirs of water placed in those situations where they would be the most speedily and effectually available; second, that there should be a provision made for the certain and adequate supply of these reservoirs.

"With these objects in view, I propose four slate tanks, capable of holding, say 1,000 gallons each, to be placed in the triforium of the nave, one at each end of the north, and one at each end of the south triforium. Also four similar tanks similarly arranged in the triforiums of the choir.

"I propose also to place two similar tanks in the gallery, under the windows of the great central tower.

"For the supply of these tanks I would lay on from the main of the waterworks company iron service-pipes to each tank, about two inches diameter; these should discharge themselves with a ball cock into the tanks.

"In order to supply the two tanks in the central tower, (which would be far above those in the triforium,) I propose two common force-pumps to be attached to two of the triforium tanks, so that in case of fire, while the engines on the ground are serving these latter tanks, men might, by working the force-pumps, be constantly forwarding the water up to the highest level.

"I have now shown by what means I think a constant and certain supply of water may be secured at ten different places of the Minster.

"To make use of this water I propose a small portable engine to be kept in each triforium, with an adequate length of hose; by means of these engines fire could be reached, whether it existed in any of the vaultings or roofs, or in the wood fittings of the choir. A similar engine with hose should also be kept in the gallery of the central tower, by which water could be poured through the windows, down on to either of the four roofs which abut upon that tower.

"As the choir is, perhaps, from the nature of its internal fittings, more exposed to danger than any other part of the building, I propose to have at the level of the pavement, within the choir, one or two screw fire-cocks; from these a pipe should be laid directly communicating with the company's main, and the hose of the Minster being made to screw on to them, a certain and abundant supply of water would be thus secured just at that part of the building where the supply is most likely to be serviceable.

"I conceive that an arrangement, the outlines of which I have here sketched, would furnish for the fabric a very effective protection against future destruction by fire.

"With regard to the expense, it is obvious that, from the great length of service-pipe necessary to conduct water to these ten tanks, the plan could not be carried out satisfactorily without incurring much expense.

"Presuming that the water company would, at their own cost, lay down the requisite main as far as the south wall of the Minster, I calculate the probable cost of the whole of the works, exclusive of any additional fire-engine that may be required, but including seven portable engines, and say four hundred feet of hose, at not less than from seven to eight hundred pounds.

"I am, Sir, your most obedient servant,

"SYDNEY SMIRKE.

"Charles Thiselton, Esq., &c. &c.

STEAM NAVIGATION.

The Peninsular and Oriental Steam Company's Steam-ship "Royal Tar."—This vessel, which for some months past has been under the hands of Messrs. Miller, Ravenhill and Co., the eminent engineers, getting new boilers and a thorough repair to the machinery, was tried upon the river Monday last, and worked most satisfactorily. We do not know that any more striking proof of Messrs. Miller and Co.'s great abilities as engineers could be adduced than is afforded by the difference between the past and present performance of this vessel, and we conceive it must be a useful service to the public, and is only an act of justice to these distinguished engineers, to state such facts as may be illustrative of the relation which subsists between the quality their machinery and that of other makers esteemed as eminent.

The engines of the "Royal Tar" were constructed by Messrs. Scott, Sinclair, and Co. in 1838, and were supplied with steam by three cylindrical boilers, with a double tier of fire-places, constructed by the same makers. The consumption of fuel with these boilers was upon an average about 24 cwt. per hour. With the boilers of Messrs. Miller and Co. the consumption of fuel has been found to be 3,095 lbs. in $2\frac{1}{2}$ hours, and taking into account the waste consequent upon the cleaning of fires, careless firing, &c., there is every reason to believe that the consumption will not exceed 12 cwt. per hour,—*only one half of the preceding consumption.*

The engines of the "Royal Tar" are of the common side-lever description; the diameter of the cylinders are 60 inches; the length of the stroke 5 feet, 7½ inches. A consumption of 24 cwt. per hour of coal is not, at least in the northern parts of the island, reckoned a large consumption for engines of this size. It is one of the strongest proofs of the consummate skill of any co-partnery of engineers, to find them extracting the same mechanical virtue from 12 cwt. of coals, that many other engineers, and those favourably known too, can only extract from 24. And nothing is more certain that Messrs. Miller and Co. do the same work with an expenditure represented by twelve, that Messrs. Scott, Sinclair and Co. can only effect with an expenditure represented by four-and-twenty. Such statistics are peculiarly interesting to the directors of steam-packet companies, who in such results may often read the success or failure of their speculations.

The West India Mail Steam Packet Company.—We shall probably in our next number present our readers with some analysis of this undertaking, which appears to us to be one of the worst planned and worst managed speculations that the annals of steam enterprize can furnish. Among the directors or managers there appears to be a destitution of capacity, which, looking at many of the names, we should have supposed impossible. That there may be talent of that description which manifests itself in plausibility and gasconade, we do not deny; but talent of this kind is at all times dangerous, and at no time more so than when exerted in the service of a steam-packet company. It appears to us, that in the whole concern there is not a single person experienced in the conduct of steam navigation as extended to distant countries; yet such experience was surely procurable, and had the directors condescended to avail themselves of it, it would have done more for the enterprize than the magisterial imbecility of a thousand rhetoricians. The vessels are all unsuited to the purpose; they are too large, and their maintenance is too expensive. There are too many nice dependencies in the arrangement of the route, whereby one late or stray vessel throws the whole train into confusion. The course, too, is extremely zigzag. Corunna, in particular, is much out of the way. Under existing conditions, we do not see that this concern can have any possible prospect except that of getting deeper and deeper into difficulties. A radical change is indispensable, and, we may add, inevitable; and we shall not cease to agitate the question until it has been carried into effect.

The "Precursor."—This is a steam vessel of about 1,700 tons burthen, and 500 horses' power, constructed by Mr. Robert Napier, of Glasgow, for the Eastern Steam Navigation Company, and intended to maintain a steam communication between Suez and Calcutta. She is a beautiful specimen of naval architecture, and is as strong and as efficient as she is handsome. The voyage from the Clyde to the Thames, a distance of above 750 nautical miles, she performed in less than 70 hours—a rate of speed under the circumstances wholly unprecedented. The engines are a very substantial piece of workmanship, and upon the whole are superior to any thing of the kind we have yet seen from the Clyde. The wrought-iron work, however, is not well proportioned, and the plan of the boilers we look upon as defective. The vessel is well equipped, the cabins well arranged, and, taken altogether, we must pronounce the "Precursor" to be a credit to the Clyde, and the best specimen of naval architecture we have ever met with.

A NOTE UPON BELLS.

We are accustomed to pride ourselves in this country upon the magnitude of our works in metal. A cylinder of 90 inches in diameter is looked upon as a prodigy of the founder's art; and a sole plate and condenser for a marine engine of the weight of 20 tons, may be said to be one of the largest castings our founders have yet executed in this country. We are wont to reckon ourselves far in advance of all other nations in the several branches of the mechanical arts, and probably in the aggregate we are so. But if in the greater number of branches we excel other nations, in some branches other nations excel us. The beauty of the iron castings of Berlin, we have attempted to emulate in vain; and the magnitude of the largest castings ever made in this country is greatly inferior to that of castings made in countries with less pretensions to mechanical proficiency. The weights of some of the largest bells in this and other countries is as follows:—

	lbs.	tons.	cwts.	lbs.
Great bell of St. Paul's . .	8,400	3	15	0
Great bell of Lincoln . . .	9,894	4	17	30
Great Tom of Oxford . . .	17,000	7	11	88
Bell of Palazzo Vecchio, Florence .	17,000	7	11	88
Bell of St. Peter's, Rome . .	18,607	8	0	68
Bell of Erfurth	28,224	12	12	0
Bell of Rouen	43,000	19	12	96
Bell of St. Ivan's, Moscow . .	160,000	71	8	64
Great bell of the Kremlin . .	443,772	198	2	28

RAILWAY ON PILES.

Our attention has been called to a mode of constructing some railways in America, which deserves to be better known here. It is that of carrying the rails on strong longitudinal bearers, supported by piles four feet apart, at some height above the ground. It appears that 200 miles of the New York and Erie line, out of 400, have been constructed upon this plan, and also a large portion of the New Orleans and Nashville line, which is 500 miles long, and the plan is said to answer very well.

Piles are driven by means of a pile-driving machine, worked by steam, to a depth in the ground, and with a rapidity and force, and consequent firmness of hold, hitherto unaccomplished. Lines of rails are thus carried over swampy and marshy ground, without any of that expensive process heretofore employed, and over some portions of the country with little or no trouble in levelling. The machine is that which was employed on the Surrey side of the New Hungerford Market Bridge.

We are informed that six of these machines will drive the piles for seven miles of railway in a month, and, as we understand it, saw off the piles to their proper height, fit for laying down the longitudinals and rails. If such be the case, a line of railway might be laid down in a very few weeks.

If this plan can be carried out, certainly a vast expense in levelling, ballasting, purchase of land, &c., might be saved, and a great subsequent annual expense in the wear and tear of the road. Having succeeded so well in America, we think it is well worthy of the attention of our engineers.—*Railway Magazine.*

MISCELLANEOUS.

Boiler Explosions.—At a recent meeting of the Paris Academy of Sciences, a paper was read from M. Jobard, of Brussels, on some experiments which he proposes to make, with a view of ascertaining the best means of preventing the explosion of steam-boilers. The principal experiment proposed by M. Jobard is such a construction of the boiler as will permit, when the mixture of explosive gases has been formed, the introduction of a stream of atmospheric air, so as to render them inexplosive.—*Leeds Conservative Journal, 21 May.*

Iron Wire Bridge.—It is strange that the plan of making bridges of iron wire, so successfully adopted in Switzerland, France, and elsewhere abroad, should not yet have found favour enough in England to be fairly tried on the large scale; the noble bridge at Freyburg, in Switzerland, is 301 feet wider than the Menai Bridge, and though it consists of one span, it is at least equally strong, and cost only a fifth part of the money. The wire bridge of Freyburg is 870 English feet span; that of Menai 569. The Menai bridge cost £120,000, that of Freyburg, £25,000.—*Patchwork, by Captain Basil Hall.*

Artesian Well at Grenelle.—The sand and clay, which have so long rendered the water of the Artesian well thick and muddy, appear to be completely exhausted, and for some weeks the flow has been uniformly as clear as well-filtered river water.

Steam Navigation.—Our infinite superiority in all that appertains to steam navigation, still remains undisputed. Even France, with all her jealousy, continues to be beholden to us for her best machinery. A steamer has left the Thames this week, which has been built expressly for the navigation of the Rhone: it is an iron boat, 185 feet long, of 270 tons measurement, drawing only one foot ten inches of water, fitted up with a pair of first-rate engines of 110 horse power, by the eminent house of Miller, Ravenhill, and Co., of Blackwall. From all accounts, it will astonish the French, affording, as it does, such striking evidence of the great

perfection we have attained in marine engineering. Mr. Miller was the first engineer that mastered the formidable difficulties of navigating the rapid and shallow Rhone by steam; and the engines in question are the twenty-fifth pair which his house has made for the company that undertook to carry into effect his plans. We have reason to be proud of such men as Mr. Miller, the benefit of whose exertions are not confined to their own country.

Important Invention.—A trial was made at Liverpool, last week, of a new method of propelling steam-boats, invented by Mr. E. Finch, for which purpose a small steamer had been constructed at the engineering establishment of Mr. Rigby, at Hawarden; the experimental trip was performed in so satisfactory a manner as to convince all parties that this new propeller is of great importance, and, when fully developed, will be as generally applied to sailing-vessels as to steam-packets. The invention appears a simple contrivance; the paddle-boxes are still preserved, but, instead of wheels, two plates are applied, the broadest parts of which are at their extreme ends fixed obliquely at an angle of 40 degrees, one on each side of the vessel, at the ends of the paddle-shaft; these plates, or propellers, are made of wrought-iron, and appear very strong and compact, and about eleven feet long, and 3 ft. 6 in. wide in the broadest parts: they are entirely out of the water twice in the revolution of the paddle-shaft, when the engine is on her centres, and have the deepest hold of the water when the engine is at half-stoke, or at its greatest power. They thus act like oars, or sculls: no back water is created, and the disagreeable beating of the paddle-boards on the water, and subsequent vibration of the vessel, is avoided.

Electro-Magnetism as a Moving Power.—The Consul-General of the Netherlands, in a communication dated the 18th ult., thus announces the removal of the hitherto great obstacle to the practical application of electro-magnetism as an effective propelling power:—"A private gentleman, Mr. Elias, of Haarlem, has just published the description of a new machine invented by him, for the application of electro-magnetism as a substitute for steam. The object of the inventor has been chiefly to remedy the defects which, in 1839, rendered the otherwise ingenious invention of Mr. Jacobi, of St. Petersburgh, a total failure, in as far as practical utility is concerned. Those defects originated, it seems, in the erroneous supposition that the power of the magnetic bars exclusively resides in their extremities—whence the form hitherto given to all electro-magnetic machines—viz., that of a horse-shoe—which, while it occasions an unavoidable interruption of the magnetic steam at each new inversion of the poles, at the same time leaves the power resident in the remaining part of the bars wholly unemployed. The new invention of Mr. Elias, on the contrary, has the very great advantage of rendering effective the full power of the magnetic stream uninterruptedly, and throughout the whole body of the apparatus. This consists of two concentric rings of soft iron, standing on the same plane, of which the external one is immoveable, while that on the inside revolves round its axis. By means of a piece of copper wire, wound about each of these rings, he has given them six magnetic poles, placed at equal distances from one another, the whole being so contrived that the one ring exerts its inducing power on the other throughout the whole circumference, and always at the same distance. A small, but very perfect model of this important invention is now open to public inspection here; and the result of its operation is allowed, by those skilled in such matters, to be such as to ensure the most triumphant success."

Steam Navigation on the Thames.—There are now 16 steam-vessels running daily between Gravesend and London, the same number to Woolwich, 20 to Greenwich, numerous small steamers, the boats of the Waterman's Company, and of the Old Woolwich Company—between Greenwich and Blackwall; there are eight steam vessels constantly going up and down the river on their way to and from Dover, Ramsgate, Margate, Herne Bay, Southend, and Sheerness. The General Steam Navigation Company muster 49 steamers, all sailing from London, a fleet superior to the steam fleet of any of the continental powers, and which carry merchandise and property to the amount of £1,000,000, sterling weekly, and whose consumption of coals exceeds in value £50,000 per annum. There are not less than 50 other large steam vessels trading between London and various ports in Great Britain and Ireland; 23 steam-tugs, carrying from 30 to 100-horse power each, exclusively engaged in towing ships between Gravesend and the Pool; 20 iron and wooden steamers navigating the river above bridge, between London-bridge and Chelsea; two constantly running between the Adelphi pier and Putney, and five to Richmond. Among the novelties lately introduced in steam navigation, is a vessel with locomotive engines, similar to those on a railway, working at a high pressure, and the Waterman, No. 7, with Stevens's patent paddles, which enter the water at an angle of 35, produce very little swell, avoid the backwater thrown up by the ordinary paddles, and produce little vibration. With two or three exceptions, the steam engines in our river vessels are worked at a low pressure.

Caledonian Canal.—The report of the select committee on the Caledonian Canal has been published. The committee state that, after the report of Sir E. Parry, they deem it unnecessary to enlarge upon the necessity for at once taking some decisive course with regard to the Canal. Three courses were open to them,—1st, To execute only those works which are absolutely necessary, the expense of which is estimated at £25,000. 2ndly, In addition to those works, to improve the navigation of the whole line of the Canal, and to establish five steam tugs, the expense of which has been estimated at £150,000. 3rdly, To abandon the Canal altogether, in which case the expense is estimated at £40,000. The first of these propositions they think it unwise to adopt, as no additional facilities would be afforded on the canal, and no additional traffic created. The Committee, therefore, recommend that Mr. Walker's report of 1839 shall be immediately acted upon, by the establishment of steam tugs, and other measures therein recommended. They think that the trade in that case would so increase, as to afford a fair return for the outlay. They agree with Sir E. Parry that such would be the saving to vessels using the canal in preference to the north about passage, that the dues may safely be doubled. The debt due from the Commissioners of the canal is £51,568. If the canal were to be abandoned, it would cost at the lowest estimate £40,000 to restore the waters of Loch Lochy to their original level. But the expense of putting the canal into a complete state of repair, would be £110,000, and they therefore do not think it would be expedient to sacrifice the £91,561, when so small a sum (comparatively) would effect the subject. The Committee, therefore, recommend the completion of the canal, according to the reports of Sir E. Parry and Mr. Walker, and that the necessary steps should be taken without delay. The Committee also think such changes ought to be made in the constitution of the Board of Commissioners, as will ensure a constant superintendance of the works.—*Glasgow Constitutional.*

The Earthquake.—A report has been drawn up by Mr. Hunt, for the Polytechnic Society, of the particulars of the earthquake felt in Cornwall, on the 17th of February last; from which we collect the following particulars:—In the neighbourhood of Falmouth the noise attracted attention, although but few persons felt any tremulous motion. At Penryn the disturbance was more decidedly felt, doors were shaken, and the earthenware rattled on the shelves. At Roosanooth, and down the valley, the shock was considerable, and the first impression was that the powder mills in the neighbourhood had exploded. The inhabitants of the villages of Comfort and Lammer, about the junctions of the granite and killas, or clay slate, left their houses, thinking that some serious explosions had occurred at the neighbouring mine. At Cann Marth, a widow woman ran out shrieking that the side of her house was falling in. In Poldory, the shock was felt by the men working 130 fathoms below the surface. In other places it was felt even more intensely; and at Constantine doors flew open, persons were shaken in their beds, and some men working in the house ran out to know what was the matter. At Helstone the disturbance was considerable. At West Wheal mine, men at work in the 100 fathom level felt a shock, and as it were a rush of air, so much so that one of the candles was put out by it, accompanied by a noise which made them think that one of the shafts had crushed in. This appears to have been the most westerly part at which the tremor was felt, although the noise was heard further, but in diminished force. Mr. Hunt states that, on referring to a geological map of the county, it will be found that the greatest effects were produced near the edge of the granite mass, which extends from the north-east to the south-west, Cann Marth to the south of Penryn. Although it was felt at Falmouth, Helstone, and other places which are on the clay slate, yet all his inquiries went to show that it diminished rapidly in force as the distance from the granite increased.

Boulton and Preston Railway.—We understand that the Directors of this line, finding their long protracted efforts to form a tunnel under the turnpike-road at Hartwood Green, near Chorley, of no avail, have determined to throw it open. The attempt to form a tunnel has cost many thousands of pounds.—*Preston Chronicle.*

Holyhead Steam-packets.—The Admiralty are now fitting up a steam-boat of greater horse power for the Holyhead and Dublin station than has yet been employed on this line. The object the Post-office authorities have in view by this, is to insure the passage between Holyhead and Dublin in 4½ hours. The captains on the station are quite sanguine as to its success.

Bristol and Exeter Railway.—For the purposes of this railway, a bridge has for some time been in course of erection over the river Parrett. The centre on which the masonry has been formed is now removing, the

work having been some time since examined by Mr. Brunel, and pronounced safe. This bridge is 103 feet span, and is supposed to be one of the handsomest structures of the kind in the West of England.

LIST OF PATENTS.

Continued from page 128.

(SIX MONTHS FOR ENROLMENT.)

Henry Barclay, of Bedford Row, London, for "a composition or compositions applicable as tools or instruments for cutting, grinding, or polishing glass, porcelain, stones, metals, and other hard substances."—Sealed April 30.

John Robinson, of Watney Street, Commercial Road East, engineer, for "improvements in windlasses and capstans."—Sealed May 3.

John Railton, of Blackburn, Lancaster, machine maker, for "certain improvements in machinery or apparatus for weaving."—Sealed May 7.

Godfrey Wetzlar, Myddleton Square, Clerkenwell, doctor of philosophy, and master of arts, for "improvements in rendering fabrics waterproof," being a communication.—Sealed May 7.

Joseph Warren, of Heybridge, Essex, agricultural implement maker, for "certain improvements in ploughs."—Sealed May 9.

Francis Prime Walker, jun., of Manchester, coal merchant, for "certain improvements in the manufacture of candles, candlesticks or candleholders, and in the apparatus connected therewith."—Sealed May 9.

George Hawe, of Manchester, gent., for "certain improvements in machinery or apparatus for sweeping and cleaning chimneys and flues."—Sealed May 9.

Thomas Edge, of Great Peter Street, Westminster, gas apparatus manufacturer, for "certain improvements in apparatus for measuring gas, water, and other fluids."—Sealed May 9.

Samuel Hall, of Basford, civil engineer, for improvements in the combustion of fuel and smoke."—Sealed May 9.

Jacob Wilson, of Wigmore Street, Cavendish Square, upholsterer, for "certain improvements in bedsteads."—Sealed May 9.

William Sanderson, of Aldermanbury, silk manufacturer, for "improvements in weaving fabrics to be used for covering buttons."—Sealed May 9.

John Melville, of Harley Street, Esq., for "certain improvements in propelling vessels."—Sealed May 11.

John Brown, of Brighton, gent., for "improvements in the manufacture of mud boots and overalls."—Sealed May 12.

Thomas Williams, of Bangor, smith, for "an improved churn."—Sealed May 17.

William Brunton, of Neath, Glamorgan, civil engineer, for "an improved method or means of dressing ores and separating metals or minerals from other substances," for the colonies only.—Sealed May 19.

Joseph Gibson, of Birmingham, manufacturer, for "certain improvements in axletrees and axletree boxes."—Sealed May 23.

John Benner Lawes, of Rotherhampton, gent., for certain improvements in manures."—Sealed May 23.

James Pilbrow, of Tottenham, engineer, for "certain improvements in steam engines."—Sealed May 23.

John Bishop, of Poland Street, Westminster, jeweller, for "a new or improved construction of brake apparatus applicable to railway carriages."—Sealed May 23.

Thomas Middleton, of Loman Street, Southwark, engineer, for "an improved method of preparing vegetable gelatine or size for paper, and also an improved mode of applying the same in the manufacture of paper," being a communication.—Sealed May 23.

William Tudor Mabley, of Henrietta Street, Covent Garden, mechanical draughtsman, for "improvements in machinery or apparatus for making nails," being a communication.—Sealed May 23.

Benjamin Cook, jun., of Birmingham, brass founder, for "improvements in the construction of bedsteads, both in metal and wood."—Sealed May 23.

Frederick Goos, of Manchester, jacquard machine maker, for "certain improvements in the jacquard machine or apparatus to be used or employed in looms for weaving."—Sealed 23.

Sir James Murray, of Merrion Square, Dublin, doctor of medicine, for "an improved method of combining various materials in a manner not hitherto in use for the purpose of manure."—Sealed May 23.

William Geeves, of Old Cavendish Street, gent., for "improvements in machinery for cutting cork."—Sealed May 24.

James Stewart, of Osnaburg Street, Regent's Park, piano-forte maker, for "improvements in hinges for piano-fortes and other purposes."—Sealed May 24.

Thomas Waterhouse, of Edgely, Chester, manufacturer, for "a certain improvement or improvements in machinery for carding cotton, wool, flax, silk, and similar fibrous substances."—Sealed May 24.

Joseph Duce, of Wolverhampton, lock manufacturer, for "an improved lock, and key to be used therewith, and an improved slide bolt for the said lock, applicable also to other purposes."—Sealed May 24.

James Boydell, jun. of the Hope Farm Works, Dudley, Stafford, iron master, for "improvements in the manufacture of keel plates for vessels, iron gates, gate posts, fencings, and gratings."—Sealed May 24.

James Potter, of Manchester, manufacturer, for "certain improvements in machinery for spinning cotton, flax, and other fibrous substances."—Sealed May 25.

Peter Kagenbusch, of Whitby, in the county of York, for "an improvement in the dyeing of wool, woollen cloths, cottons, silks, and other fabrics and materials."—Sealed May 26.

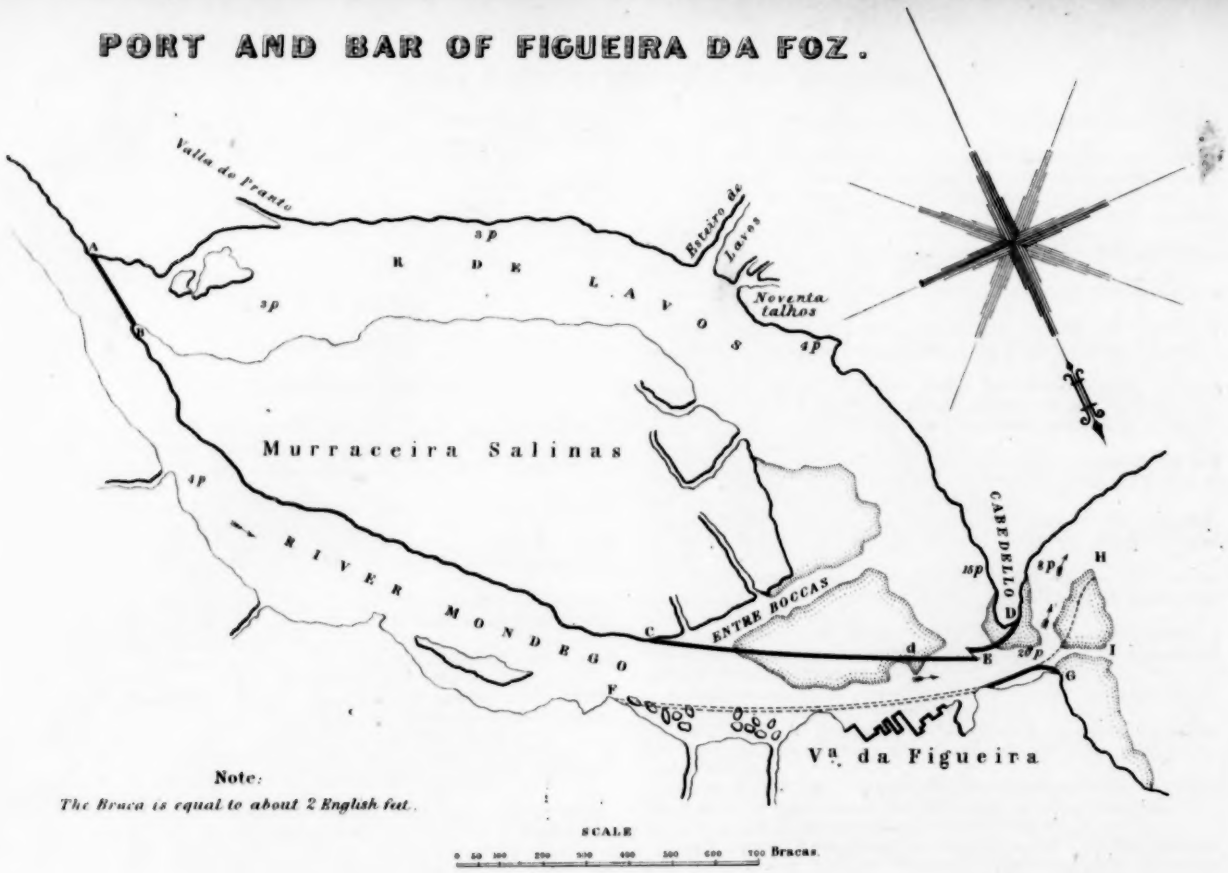
ADVERTISEMENT.

In consequence of Mr. Mudie's death, the management of the SURVEYOR, ENGINEER, AND ARCHITECT, has passed into different hands. The work will appear as usual on the first of every month; the editorial department is conducted by an engineer and an architect. It is requested that all communications may be sent to the Publisher's, or to the Printing Office, 90½, Holborn Hill, on or before the 20th of the month. Those relating to architecture should be addressed "To the Architectural Editor," and those relating to all other subjects "To the Engineering Editor."

ERRATUM.

In p. 151, col. 2, line 26, for $e=36$ read $s=36$.

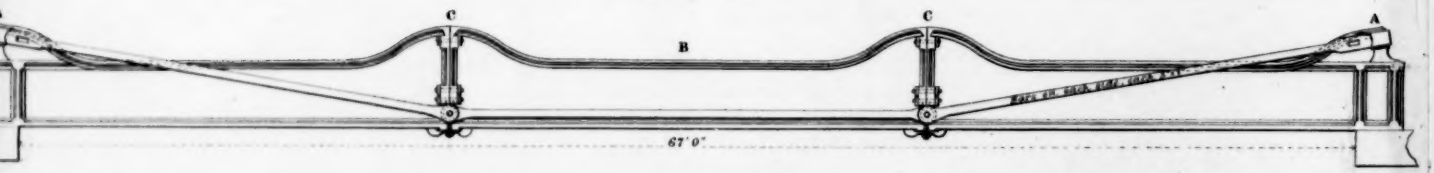
PORT AND BAR OF FIGUEIRA DA FOZ.



Note:
The Braca is equal to about 2 English fat.

SCALE
0 50 100 200 300 400 500 600 700 Bracas.

ELEVATION



LONDON AND BLACKWALL RAILWAY.

ONE OF THE GIRDERS OF THE BRIDGE, ERECTED OVER THE MINORIES.

SECTION AT A.

SECTION AT B.

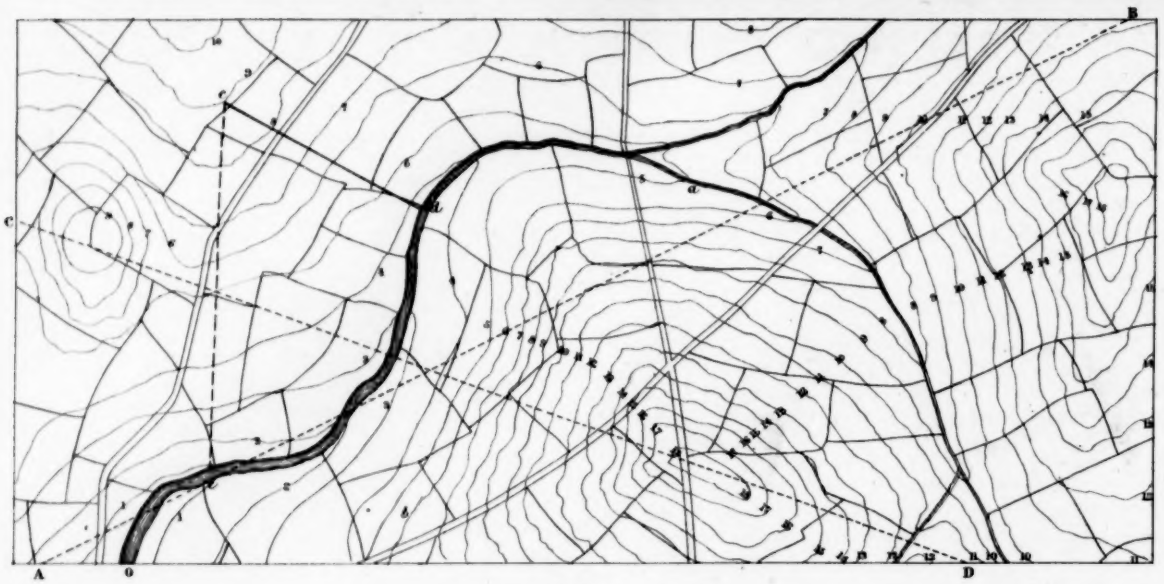
SECTION AT C.

Scale for Elevation, 8 feet to the inch. Scale for Detached Parts, 4 feet to the inch.

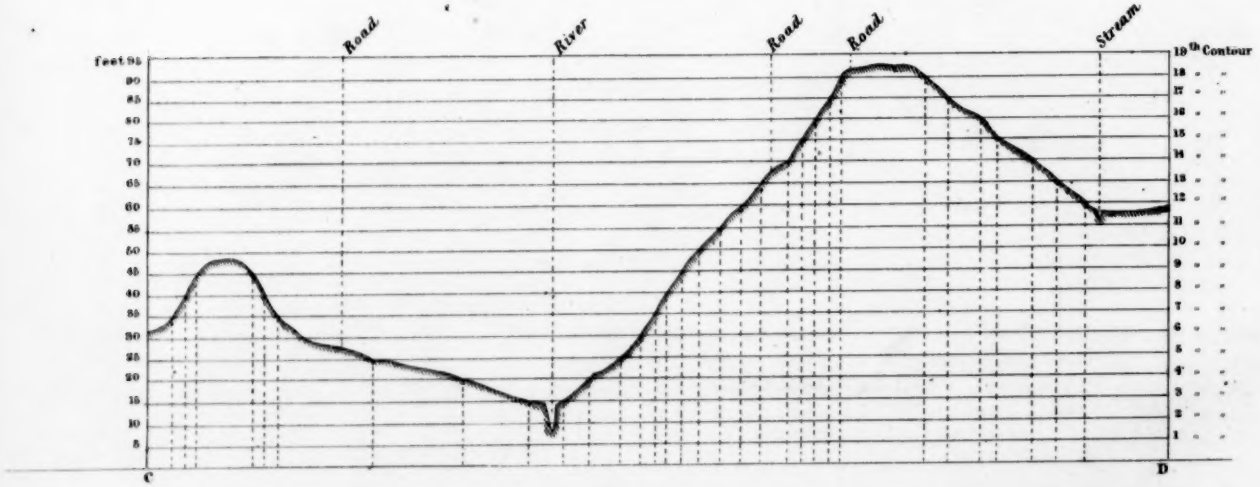
J.R. Jobbins Lith.

PLAN OF AN ESTATE

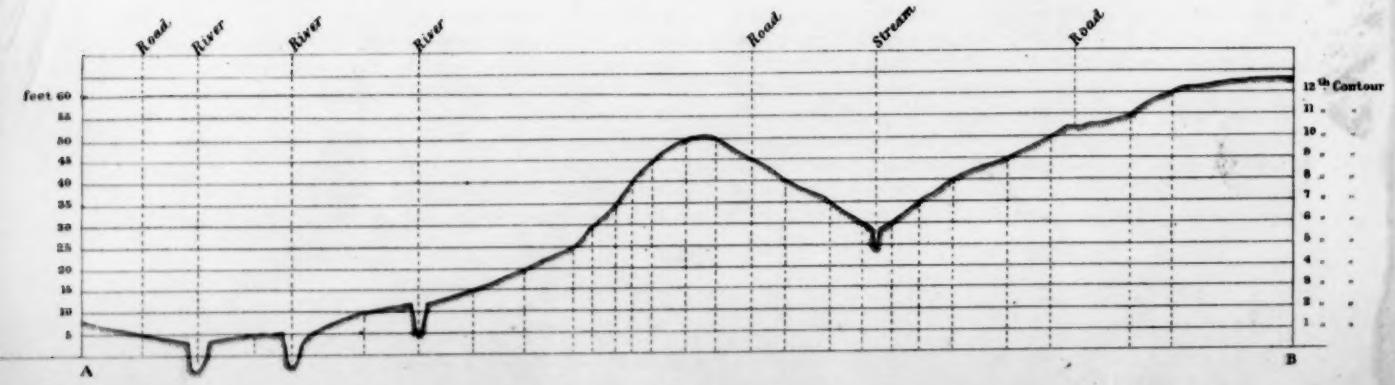
WITH NORMAL CONTOURS TRACED UPON IT.



SECTION FROM C TO D



SECTION FROM A TO B



J. R. Jobbins Litho